on the History
And Natural Arrangem of
Insects
Part-1

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ON

THE HISTORY

AND

NATURAL ARRANGEMENT

OF

INSECTS.

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PART I.

ON THE ANNULOSA GENERALLY.

CHAPTER I.

ON THE ANNULOSE ANIMALS IN GENERAL, WITH A SHORT ACCOUNT OF THE THREE ABERRANT CLASSES OF ANNELIDES, VERMES, AND CIRRHIPEDES.

(1.) The great characteristic of the vast assemblage of animals to which we devote this volume, is the total absence of internal bones; hence their hardest parts are always external, and the muscles are usually attached to the under side of the substance which forms the covering of the animal. The body is always divided into rings or transverse joints, from which circumstance naturalists have agreed to call them annulose, or ringed animals. This name is peculiarly applicable, since it expresses a marked distinction from such as have an internal skeleton, analogous to that of man, and thence called vertebrate (*vertebrata*). We need not, in this place, touch further upon the internal structure of these creatures, but we shall notice those external peculiarities which are most obvious, and therefore most likely to be understood by the generality of our readers. So diversified, indeed, are the different groups of this immense assemblage, or sub-kingdom of the animal world, that it is impossible to assign to them any other character, as a whole, than that just mentioned.

(2.) There are, however, certain prominent peculiarities, belonging to annulose animals, which deserve the attention of every reader. The *Annulosa* contain both the most intelligent and the minutest objects in the animal creation; for, excepting the *Infusoria*, there are none smaller; and among winged insects we find those with the most highly developed instincts. It certainly appears strange, that beings whose form so widely differs from that of man, should nevertheless make a much nearer approach to his intellectual superiority than any of the vertebrate animals. Not one of the latter, in fact, can be compared, in this respect, with the bee or the ant. Insects, again, are remarkable for their tenacity of life. It is a well known fact, that in proportion to the complexity of animal structure, so does its sense of pain increase, and its capability to support injury diminish. Now as insects, from supplying food to so many others, are more defenceless and exposed than vertebrate animals, so do we find that they are particularly tenacious of life; we conclude therefore, that their organisation, although perfect in itself, is much less complicated than in animals of a larger size. Being thus exposed to so many casualties, they are gifted with great activity and powers of locomotion. They command two of the elements, and sometimes a third, for all inhabit the earth as much as the air, and several are likewise aquatic.

(3.) The typical examples of the *Annulosa* are provided with two or four wings, and with six feet; but in receding from this perfection, nature proceeds by the most graduated steps. At first, if the wings disappear, we find them compensated for by an additional number of feet, as in spiders and crabs. On tracing the chain further, we see these latter members gradually disappear, until, on arriving at the furthest limits of the class, there is nothing to remind us of the typical annulose structure but a long slender body, pointed at both ends, like the common earth-worm, moving about by the action of the circular rings or joints (often very obscure), of which it is composed. Some of the remote *Annulosa* externally resemble shellfish, and live in the water: others are parasitic, like the *Cirrhipedes*, or, like the worms, are destitute of limbs; while another large group, in addition to the most eccentric shapes, differ from all the preceding by having red blood, and by living either in the ocean or in moist earth. All these, however widely they differ from the pre-eminent types of this assemblage, are clearly formed upon the same general model: their body is divided into joints, more or less conspicuous, nor do they differ more among themselves than do the various classes of the vertebrate circle. Annulose animals are not only the most diminutive in size of all creeping things, but they are, beyond all comparison, more numerous than the vertebrate class. When we consider the surprising habits of the insect world in general, the high development of instinct which is found among whole families, the activity of motion, the beauty of form, and the resplendent colours which nature has so lavishly bestowed upon these pigmy creatures, we cannot for a moment hesitate to place them next in the scale of creation to the vertebrate animals, a station which we shall presently show they are entitled to hold on other and more weighty considerations.

(4) Independent, however, of the foregoing characters, which stamp a peculiarity upon the insect world, there is yet another nearly as important, which equally separates them. This is found in the extraordinary metamorphosis, or change of form, which all the typical, and some of the aberrant, groups undergo previous to arriving at their perfect state. The only other animals in creation which are known to participate in this character are the frogs, among the reptiles, and these are the most im-

perfect of all vertebrate animals. The metamorphosis of insects, however, has been invested with so much importance by some writers, that we shall hereafter return to it more fully, when treating of those divisions in which it is most strikingly developed.

(5.) The rank of the *Annulosa*, in the great circle of the animal creation, has more than once been adverted to in our former volumes: they are inferior only to the vertebrate animals in being, as a whole, less highly organised, or rather by having a less complicated structure. These distinctions, on the other hand, place them far above the three other great divisions of animals, namely, the *Testacea*, the *Radiata*, and the *Acrita*. Their superiority over these is so self-evident, that it seems impossible to conceive how any naturalist who takes nature for his guide, could think of placing the headless and almost inanimate oyster higher in the scale of creation than the bee and the ant, because the former happens to have a heart, while the latter have none. This outrage upon natural classification is one of the many instances which result from making internal structure the sole basis of scientific arrangement. It has originated, not from the legitimate use, but the abuse of our increased acquaintance with internal structure. There are professors of comparative anatomy, able but mistaken men, who are now striving to overthrow all received notions on natural affinities, and to substitute in their room certain dogmas of their own, founded on minute peculiarities of internal structure which they hold superior to all others. Against these speculative modes of classification we have frequently been obliged to enter our protest: it tends to render that which nature has made plain to every one, comprehensible to none but the closet professor. It increases rather than lessens the difficulties which already beset the study of zoology, and renders it a dry, repulsive study of bones and muscles. In reference to that theory, more particularly, which places the shellfish above insects, we may strengthen what we have here said by the sentiments of others whose writings have exhibited entomology in its most attractive garb. "What unsophisticated mind, not entangled in the trammels of system, when it surveys the industry, the various proceedings, and the almost miraculous works of insects, — the waxen palaces of the bee, the paper cottages of the wasp and hornet, the crowded metropolis of the white ants, the arts, the manufactures, the stratagems of other insects, the associations and labours for the common good of those which are gregarious, will not at once conclude that they must be a superior race to the slug, the snail, and others, which live only to eat and propagate their kind!"* Again, it has been well observed that the station which any particular group of animals holds in the scale of creation must be judged of, not by a fancied and often forced resemblance to the human structure as the only standard, but according to the ingenuity displayed in their organisation, and the variety of effects which may depend on it.† The most careless observer, indeed, is well aware that many of the vertebrate animals are far inferior to insects, both in their instincts and the complexity of their structure.

(6.) The vertebrate and the annulose divisions being thus the two most perfect classes in the animal kingdom, it necessarily results that they follow and blend into each other. We accordingly find, that the two circles touch at those points where the eel-shaped fishes come into contact with the *Annelides*, or red-blooded worms; the affinity of these groups being now so universally admitted, that we need not defend the theory of their union. On the other hand, the *Annulosa* are connected to the *Radiata* by means of the barnacles, whose long stems, rendered pliable by innumerable articulations, at once place them within the definition of annulose animals, while in many other respects they show such a strong affinity to the radiated class (*Radiata*). To understand the perfection of structure in any given group, we must always draw our definition of that group from its pre-eminent types; but, if we wish to know how it blends into other groups, the aberrant examples, or such as are furthest removed from the typical structure, must be alone regarded. No animals can be more unlike each other than a monkey and a butterfly, each of which are the types of their own class; but when we look to an eel (*Myxine*) without eyes or fins, or even a firm skeleton, we can have no great difficulty in comparing it with the leech or the earth-worm: the *Myxine*, in fact, is the last of the vertebrate circle, while the *Annelides* are the first which present themselves, on quitting the *Vertebrata*, and entering the *Annulosa*.

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* Kirby and Spence, Introduction to Entomology, iv. 364.
† Hor. Ent. 206.

(7.) Our next question, regarding the PRIMARY DIVISIONS of the annulose animals, is not so easily disposed. Were we to lay before the reader all the conflicting opinions that have been promulgated on this subject, we fear, even did our space admit of such details, we should probably perplex and certainly weary him. It has been customary, indeed, for authors to state the reasons which may lead them to reject the theories of others; and this, to a certain extent, is both necessary and useful. But in the present case, it would lead to so much discussion, that it must from necessity be avoided. Our object is, not to criticise the opinions of others, but make good, so far as we can, our own theory upon the natural arrangement of all animals. The plan, therefore, which we have hitherto pursued in other classes will be continued to this: and the results must be our apology for rejecting all former arrangements of the *Annulosa*. We shall therefore first intimate what appear to be the five great divisions or classes of the insect world, and then point out their analogies to all other animals. The *Annelides*, as already intimated, constitute one: they are all aquatic, worm-like animals, known by having usually red instead of white blood: while their bodies, from being articulated, at once prevent them from being confounded either with the slug-like *Mollusca* or the *Polypes*. The next great division which shows an evident resemblance to the last, is the intestinal worms; being of the most simple structure, but the greatest part of which exhibit, although but faintly, the annulose jointed body, which at once decides that their structure is truly annulose. The types of these are chiefly composed of the *Tænioïdea* of Cuvier, but there are several other forms among the *Entozoa* of Rudolphi, which will ultimately be referred to this type, an assemblage which appears to us in very great confusion. The third aberrant division is distinguished from the two last, by having five pair of feet, branching off into articulated fringed cirrhi: these are the *Cirrhipedes*, or barnacles. It was reserved for a countryman of our own, Mr. Thompson, to make known the extraordinary fact, that these animals undergo a metamorphosis; a discovery which at once removes all doubt on their natural station. These appear to us the three great aberrant groups of the *Annulosa*. The general reader will have a very good idea of them, by looking to an earth-worm as an example of the *Annelides;* a tape-worm as representing the class *Vermes;* and a barnacle as representing that of the *Cirrhipedes*. These three classes unite themselves, in all probability, into a circle of their own; for it is a remarkable fact, that Cuvier places the *Cirrhipedes* immediately contiguous to the *Annelides*, thereby tacitly confirming the position we have so frequently advanced, that there is a tendency in all aberrant groups to unite into one circle. Leaving, however, these imperfect *Annulosa*, we next come to those whose bodies are provided with distinctly formed legs and jointed feet, and of whose annulose structure there can be no doubt. These, we consider, after the example of Aristotle and Linnæus, as naturally arranged under two great groups or classes; the first comprising the *Aptera*, or wingless insects, further distinguished by undergoing that particular metamorphosis which tends to give an increased number of legs to the perfect insect. The second is the *Ptilota* of the philosopher of Stagira, or the winged insects, whose metamorphosis tends to give *wings* to the adult. These we place as the typical and the sub-typical groups of the *Annulosa*. Thus it may be said that in a leech, a tapeworm, a barnacle, a spider, and a butterfly, we have the respective types of the five great divisions of annulose animals, in the order here mentioned.

(8.) Our next proposition is, that this assemblage or sub-kingdom (equal in rank to the vertebrated division) forms a circle of affinity more or less complete, the only hiatus being in that part which intervenes between the *Annelides* and the *Ptilota*. It will be seen, however, that this hiatus is of no great consequence in reference to our present purpose; because as the *Annelides* come next to fishes, and there is no other break in the chain from them to the *Ptilota*, we establish the series of the five types, and can readily suppose an intervening form yet undiscovered among the thousands that still remain unknown, which may unite the aquatic *Annelides* to the aquatic *Neuroptera*, the most aberrant class of the *Ptilota*. Commencing, then, with the *Annelides*, the resemblance between the earth-worms and many of the *Vermes* is sufficient to satisfy the ordinary observer of their close resemblance; while the fact of Lamarck having had no hesitation in placing them together, on account of their general similarity of structure, will have due weight with the scientific naturalist. So little is yet known of the genuine annulose *Vermes*, that it would be premature to say in what manner they are connected to the *Cirrhipedes*; but the precise station of these latter in the circle of the *Annulosa* is rendered certain:—first by their forming the passage to the *Radiata*, and, secondly, by their absolute union to the

Crustacea. This latter affinity brings us at once into the great class of *Aptera*, which we quit by means of the dipterous order, the only one of its divisions where the perfect insect is provided with wings: this order, in fact, connects the *Aptera* with the typical class of *Ptilota,* the first division of which is the *Hymenoptera.* We have now arrived among four-winged insects, and, after following the chain of connection from the *Hymenoptera* to the *Hemiptera* and the *Lepidoptera,* pass, by the latter, to the *Neuroptera.* The circle of the *Ptilota* is closed by the *Coleoptera,* and thus the *Neuroptera,* by standing at the furthest extremity, comes nearest to the *Annelides,* or that point from whence we began. Without attempting, for the present, to combat the many objections which a first view of this theory, so different from all received arrangements, might easily suggest, we must crave the patience of our entomological readers for a short time, until, by seeing the result in all its bearings and ramifications, the whole theory becomes understood.

(9.) Assembling these primary groups of the *Annulosa* in a tabular form, we shall at once perceive that they turn out to be representatives of the five great divisions of the vertebrate circle.

Analogies of the ANNULOSA *to the* VERTEBRATA.

Classes of the *Annulosa.*	*Analogies.*	Classes of the *Vertebrata.*
APTERA.	Destitute of wings and crawling; feet highly developed, and walk.	QUADRUPEDS.
PTILOTA.	Furnished with wings, and fly.	BIRDS
ANNELIDES.	Body excessively lengthened.	REPTILES.
VERMES.	The most imperfectly organised of their respective circles; destitute of teeth.	AMPHIBIANS.
CIRRHIPEDES.	Body covered with hard plates or scales.	FISHES.

Among all the different arrangements that have yet appeared of the annulose animals, there is not one which attempts to establish any sort of relationship between them and the *Vertebrata.* This has originated from two causes:—firstly, from considering the *Annulosa* as an isolated group, whose divisions were not subject to any general or comprehensive principles; and secondly, from adopting as the basis of their arrangement a principle of classification which, as will be shown in the sequel, appears absolutely artificial. Vague, therefore, as one or two of the above analogies may appear, it is yet some satisfaction to see how strong and singularly beautiful they are in others. Of all insects, for instance, none are so perfectly organised for walking as the *Aptera,* since here we find the centipede, the *Iülus,* and many other creatures, whose legs may be almost termed innumerable. The quadrupeds, which they thus represent, are precisely in the same position, since they are the most perfect walkers of all the *Vertebrata.* The four-winged insects forming the class *Ptilota,* and at the head of which stand the butterflies, may truly be called the birds of annulose animals, which they further represent by the feathery down with which their wings are covered and the brilliant colours with which both are ornamented. The resemblance between the serpents and the *Annelides* will be admitted by every one not blinded by system; for who that looks upon an earthworm will not be reminded of a snake? The least organised of all the *Annulosa* are the intestinal worms, some of which are so low in the scale that no articulations of their body can be discerned. In this imperfection they resemble the amphibians, the most imperfect of the *Vertebrata,* and where the naked skin is entirely unprotected. Lastly, the *Cirrhipedes,* without having the least resemblance in external form to fishes, nevertheless resemble them in having the body covered with hard plates, and always living in the water. These are only the most prominent analogies, but they are such as will strike a common observer; and however they may be extended hereafter, are at least sufficient to show a mutual relationship between these two great divisions of animals hitherto undiscovered.

(10.) Before taking leave of these analogies, it will be as well to make a few additional observations relative to the two typical groups. As we wish to meet difficulties rather than to avoid them, we may here anticipate an objection that may be urged against the theory of the *Ptilota* being the pre-eminently typical group of the *Annulosa*. If, it may be argued, the annular rings of which their body is composed be the chief characteristic of insects, then it would reasonably follow, that those which have the greatest number of these rings are the most typical. The consequence of this admission would be, that the *Aptera* (at the head of which stands the *Iülidæ*) would become the most typical *Annulosa*. This theory appears to receive additional support from the fact that the *Aptera* in our table stand in a parallel line of analogy to the quadrupeds, which, in many other respects, they certainly represent. The *Ptilota*, or winged insects, having fewer segments to their body, thus become the sub-typical group, holding the same rank among *Annulosa* as birds do among *Vertebrata*. These arguments, which are certainly entitled to much consideration, for a long time excited strong doubts in our mind as to which of these we should apply the term *typical*. On the other hand, if we embrace the received opinion that metamorphosis is the great characteristic of these animals, then the difficulty is solved, since this peculiarity is only seen in its full development among the *Ptilota*, which would thus become pre-eminently typical. Besides, in all the groups of the animal kingdom which we have investigated, — and our readers are now aware that the number is not small, — we have invariably found that the most perfect animals, that is, those whose organisation or instincts were most superior, were invariably the *typical*. In this way *Vertebrata* are superior to *Annulosa*, quadrupeds to birds, the *Quadrumana* and the *Insessores* to the *Feræ* and the *Raptores*, and so on. When, therefore, we find this principle so general, we have every reason to believe it must be also true in the present instance. What person, in fact, whether naturalist or not, who knows any thing of the bee or the ant, would ever think of classing them as inferior in the scale of creation to a spider, a woodlouse, or a scorpion? Now the group which contains these two highly-gifted families is that of *Ptilota*, which we consequently infer is the typical class of the *Annulosa*. This question, after all, is purely speculative, for whether we reverse our original position, and adopt the opposite opinion before mentioned, it will have no effect whatever in altering that progression of affinity which results from analysis. Affinities must be traced in detail, and therefore analysis is the only sure road which the investigator of the natural system should venture upon in his first advances. Analogies must be discovered after: they are, indeed, indispensable, but they are not to supersede the facts resulting from analysis. It will frequently happen that from ignorance, either of habits or structure, we are at one time unable to trace the analogies of two groups, which subsequent information has proved to be analogous.

(11.) The analogies now shown to exist between the primary groups of the vertebrate animals, and those in which we have distributed the *Annulosa*, leads to several conclusions, not at first apparent, yet intimately bearing on several questions of the highest importance. In the first place, presuming this exposition is correct, we arrive at a definite conclusion on the *rank* or value of the groups thus brought into comparison. Those, indeed, of the *Vertebrata* have been long ago settled, not only by the common consent of the most eminent modern zoologists, but by the searching analysis to which they have been submitted in our former volumes. We know, moreover, that as the *Annulosa* form one of the primary divisions of the animal kingdom, its contents cannot be correctly distributed, unless they correspond, in some measure, with the contents of the vertebrate circle. Without this there could be no mutual relationship, no harmony of parts; and all that has been written on the analogies of the animal creation would fall to the ground. Either the natural arrangement of the *Annulosa* coincides with those principles which regulate the variation of the *Vertebrata* and all other animals, or we must adopt the preposterous supposition that they have been formed upon a totally different plan. Now this idea, improbable in itself, is falsified by the comparison we have just laid before the reader. It therefore follows, that no arrangement of the *Annulosa* can, by any possibility, be a natural one, unless it developes analogies to the *Vertebrata* equally strong with those we have just stated. We are not now speaking of the details, for an arrangement may be substantially true in its outlines,—it may even be based on the foundation of truth, and yet may be defective or erroneous in some parts of its superstructure. This, however, is an after-consideration. The primary groups, still less the general principles, will never be affected by such inaccuracies; and in the meantime we get what is of the highest importance to the philosophic zoologist —a definite notion on the value of those groups employed in the comparison, groups which have been acknowledged by all writers, but upon whose value not any two have hitherto agreed. The *Crustacea*, for instance, were considered by the fathers of entomology as an order equivalent in value to the *Coleoptera*. But Cuvier, attaching an undue importance, as he frequently did, to these animals, breathing by a different set of organs to winged insects, made them into a class. This innovation was soon followed up by another, and Lamarck on similar grounds elevated the spiders to the same rank. This mistaken principle, once sanctioned by such names, induced almost every succeeding author to make fresh classes and orders; until the apterous insects, one of the most natural in the whole animal kingdom, have at length been thrown unto the greatest confusion: all the leading and natural divisions have been frittered away, and almost every writer brings out a new arrangement, founded upon nothing better than arbitrary opinion. Now it is quite obvious, that if entomologists had looked beyond those animals more immediately studied, little or nothing of this confusion would have arisen. They would have discovered that the *Crustacea* by no means constitute a class, for then there would have been six classes among the *Annulosa*, while the *Vertebrata* had but five. It appears to us, in short, that the *rank* of groups can only be determined by analogical comparison, a process which implies a much more general acquaintance with zoology than is usually bestowed upon it by those who merely study one of its branches. What faith or dependence can possibly be placed on the opinions of an entomologist, who proceeded to make an arrangement of the annulose division, founded entirely upon his knowledge of such only as are possessed of wings? Taken abstractedly, such an arrangement carries upon its face the certainty of error. And yet more than one of those systems for the *Annulosa*, which have obtained some degree of notoriety, have every appearance of being the offspring of such partial and contracted views. We hope not to be mistaken in this: we desire to do ample justice to the zeal and ability of all who have gone before us in the path we are now pursuing; but it is absolutely necessary to inculcate, in the rising generation, sound principles of studying nature, and to combat the idea that because an entomologist is eminent in his own walk, he is therefore competent to judge of those laws which regulate the whole of the animal creation, of which he is only acquainted with a small part.

(12.) Another inference to be drawn from the foregoing table is scarcely of less importance than that we have just mentioned. As the primary groups of the *Annulosa* are thus found to represent those of the *Vertebrata*, it follows, as a necessary consequence, that they equally represent all other groups, large or small, which agree in having analogies with the vertebrate series. This is one of the consequences of the law of universal representation, which, while it saves a world of explanatory details, reduces all the variations of animal forms to one and the same uniform law. One such table as the last, if correctly drawn up, does away with the necessity of testing the *Annulosa* by comparing them with any other circular group; although such additional comparisons would certainly tend very much to elucidate the subject, and confirm the correctness of our theory. The reader of our former volumes will perfectly understand this when he remembers that in each of those secondary divisions of the *Vertebrata*, named in our table, there is found representations of those in which the entire class is first divided; so that the different races of quadrupeds have their counterparts in the different races of birds, of fish, and so on. Hence, if one is correct, the others, theoretically, must be correct also. The student, with our former volumes before him, is thus enabled to trace the analogies of the *Annulosa* through the whole of the vertebrate circle.* But he need not stop even here. If the basis of an arrangement is natural, it will stand any test; we shall, therefore, devote one more paragraph to the analogies of the annulose animals, and then proceed to treat them in further detail. So many curious points of coincidence will thus come to light, that we trust the general reader, no less than the professed entomologist, will feel interested in our exposition.

(13.) Few classes of animals can be more different than insects and shellfish. Yet if our proposition, that each forms a circular group, is true, then it will necessarily follow that the contents of one represent the contents of the other. How far this is really the case will be judged of by the following table and the explanations which follow :—

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* See the Treatise on MALACOLOGY, or Shells and Shellfish, where the analogies they bear to the vertebrate animals and to the *Annulosa* are stated at ch. ii. p. 49.

Analogies of the ANNULOSA *to the* TESTACEA.

Classes of the *Annulosa.*	*Analogical Characters.*	Tribes of the *Testacea.*
PTILOTA.	Pre-eminently typical; head distinct, with long antennæ or tentacula.	GASTEROPODA.
APTERA.	Sub-typical; head indistinct, often confounded with the thorax, or altogether wanting; antennæ or tentacula often wanting.	DITHYRA.
CIRRHIPEDES.	Mouth surrounded with long tentacula or arms; soft parts of the body generally protected by a shell.	CEPHALOPODA.
VERMES.	The most simple in their organisation; naked; without limbs of any sort; destitute of branchiæ.	PARENCHYMATA.
ANNELIDES.	Disk of the belly flattened, and often performing the office of a foot.	NUDIBRANCHIA.

The high development of the head and of the antennæ are not the least remarkable characters of the *Ptilota*, or typical insects; while, at the same time, it is all but universal in the *Gasteropoda* to find the head distinct, and the tentacula, representing antennæ, more or less developed. The reverse of this, however, takes place in the apterous insects (*Aptera*), and the bivalve shellfish (*Dithyra*): the whole of the spiders and scorpions are familiar examples, setting aside the crabs, where the whole body at first sight appears turned into a head, without, however, its limits being at all defined. The *Dithyra*, or bivalve shellfish, are absolutely headless, and live, like their prototypes, entirely by suction. The analogies between the barnacles (*Cirrhipedes*) and the cuttlefish (*Cephalopoda*) are even more striking to an ordinary observer than the former instances. Both have the mouth surrounded by long flexible arms, with which they seize their prey and convey it to their mouth, placed, like that of the radiated animals, in the centre; and in both are numerous animals whose body is protected by shells. The strong analogy, as was formerly observed [*], between the *Parenchymata* and the annulose *Vermes* has induced all writers to blend them together, even to this day; the one being the most imperfect of all the *Testacea*, as the other is of the *Annulosa*. Leaving these, we arrive at the annulose *Annelides* and the testaceous *Nudibranchia*. Even a naturalist, looking to the outward appearance of these creatures, might readily be deceived in mistaking one for the other: their bodies, generally naked, are often ornamented with tufts of plumed or branched appendages, assuming the aspect of horns, filaments, or tentacula; they are in truth the very prototypes of each other. No wonder, therefore, that the older naturalists, and even Linnæus, mixed them together, since the fact of one having red and the other white blood was not in those days, considered of much consequence. It is seldom that analogies, so striking as these, run through all the component parts of two series of animals; for it generally happens that some are much more remote or obscure than others. The completeness, therefore, of this comparison, is an additional evidence in favour of our theory on the primary types of the annulose circle. Leaving the typical groups for the present, we shall now take a rapid glance at the three aberrant classes belonging to this division of animals.

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[*] Malacology, p. 52.

(14.) The general characters of the ANNELIDES, or at least of the animals arranged by M. Savigny in this group, may be thus stated. They are soft, worm-like animals, mostly aquatic *, either naked, or protected by an external shelly or agglutinated tube. The body is wrinkled transversely, or composed of annular segments. Their forms are very singular, and many are ornamented with beautiful colours, but these fade almost immediately after death. Their body being annular, brings them within the circle of the *Annulosa;* but their blood is red; they have usually one or more hearts, and, with very few exceptions, are destitute of a distinct head: the sexes, moreover, are not always separate, but the majority are hermaphrodites. They are without any articulated members for locomotion; although some possess processes or setæ, which can be protruded or withdrawn at pleasure, placed on each side of the body, which serve the animal as feet. The construction of the mouth is excessively variable. In some (*Nereidæ*), it is lengthened into a proboscis furnished with jaws: in the *Serpulidæ*, or worm-shells, which have a testaceous covering, there is an appearance of two lips; while in the leeches (*Hirudinidæ*), there is a prehensile cavity, supplied with parts which perform the office of jaws. The vertical movements of these parts, which so eminently distinguish vertebrate animals, is still observable in many of the *Annelides;* but what particularly distinguishes the two groups from each other, is the nervous system of these worms, which, according to Cuvier and Savigny, is longitudinal, double, and knotted, or ganglionic, like that of insects. In the leeches, this similitude extends to the same number of ganglions.* The connection of this group with the *Vertebrata* and annulose animals has been before demonstrated. We shall, however, in this place, cite the opinion of Mr. MacLeay, who writes as follows: "That the *Annelides*, thus lying between the two most perfect forms in zoology, should be so inferior in the senses and powers of locomotion to both, is certainly surprising;" but, on further reflection, we shall cease to think this anomalous, and may in some measure even expect that the vital powers of these beings ought to be influenced by the circumstance, that Nature in them is leaving one plan of construction, in order to adopt another which is totally different.

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* Hor. Ent. 280.

(15.) The affinity between these animals and the fishes, through the medium of *Gastrobranchus*, is thus stated by our author. "The common leech is a red-blooded aquatic animal, which swims, like the lampreys, in an undulatory motion. Like those animals, it has a circulation composed of veins and arteries: it breathes, like them, by two rows of holes, which communicate with branchial pouches. The mouth is still surrounded by a lip proper for suction, and contains three maxillæ,—one answering to the solitary upper tooth of the *Gastrobranchus*, and the other to the lateral teeth of its tongue. These maxillæ are minute, compressed, and serrated with very small teeth. The affinity of the leech to the cyclostomous fishes seems to have been first perceived by Linnæus, as appears by the place which he gave to his genus *Myxine*. When, moreover, we find their habits to be so similar, it may be said that nothing more is wanted to complete the resemblance, than that the wrinkled membranaceous skeleton of *Ammocœtus* should, in the leech, be supposed to form the envelope of the whole animal." Our author, nevertheless, remarks, that "a great alteration, however, has now taken place in the internal structure, notwithstanding the above very evident affinities." That the *Annelides*, on the other hand, approach to true insects, through the medium of the *Nereidæ*, or sea-worms, is highly probable. These latter are more complicated in their structure than any others, from possessing a head, antennæ, and blackish points resembling eyes: these eyes, however, are so imperfect, that Latreille compares them to the rudimentary ocelli visible in caterpillars and other insect larvæ. From the *Nereidæ*, moreover, agreeing in certain particulars, relating to their organs of reproduction, with the *Myriapoda*, Mr. MacLeay considers that there is an affinity between them. He observes, "If to these considerations be added their vermicular motion, the form and disposition of their feet,—the two last of which are sometimes, as in *Nereis margaritacea*, transformed into filiform appendages, exactly similar to those which terminate the body of several *Myriapoda*,—we can have no doubt," concludes our author, "of our having at length reached truly the annulose animals, which are white-blooded, and are externally articulated." * All these relations indeed exist, and yet may be accounted for upon the simple principle, that the *Nereidæ*, in their own circle, represent the *Myriapoda*, but without having any affinity to them. As we have had no opportunity of studying these animals, we shall depart somewhat from our usual practice, and, instead of venturing upon any arrangement of our own, shall here lay before the reader the views entertained of their natural classification by others.

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* Hor. Ent. 278.

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* Horæ Ent. p.282.

(16.) Cuvier, who first discriminated this class by the name of *Vers à sang rouge*, has arranged them into three orders, founded upon their different modes of respiration. These are named *Tubicoles*, *Dorsibranches*, and *Abranches*. The first have their branchiæ in the form of a plume of feathers, attached to the head or to the anterior part of the body; which latter is always protected by a tubular sheath. The second have the branchiæ disposed on the sides of the body, where they assume the form of little ramified branches, tufts, plates, or tubercles: the greatest number live in the mud or freely swim in the ocean; but some few inhabit tubes, like the former division. The third class comprehends such as have no apparent branchiæ, and which respire from the surface of the skin, or, as it is supposed, by interior cavities. The greatest part of these animals live at the bottom of the sea, but a few reside in humid ground, like the earth-worm. The learned Savigny divides the *Annelides* into five orders, three of which are furnished with those bristly appendages on the sides of the body which perform the office of feet, and which are wanting in the other two.* Lamarck's arrangement of the *Annelides* is founded upon the facts disclosed by Savigny. He divides the whole group under the three following orders: — 1. *Annelides apodes*, or footless *Annelides*; 2. *Annelides antennées*, or such as are furnished with antennæ; 3. *Annelides sedentaires*, or such as are fixed to other substances.

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* Mentioned in *Horæ Entomologicæ*, p. 281. The recent arrangement of MacLeay, hereafter noticed, seems to be precisely the same as Savigny's — at least, in the primary divisions.

(17.) The arrangement of Milne Edwards is the most recent; and, although leading to no general results connected with the other classes of the *Annulosa*, may here be inserted, as disclosing some important facts relative to structure, which may hereafter be turned to good account: although, where no general principles are aimed at, we seldom notice these isolated arrangements.

(18.) The author in question divides the *Annelides* into two groups: — 1. The ANNELIDES APODES, or footless *Annelides*; and, 2. The ANNELIDES CHETOPODES, which are assisted in their locomotion by setæ placed upon pediform tubercles. The former, or ANNELIDES APODES, are very inferior in point of numbers to the latter, and are distinguished by having a sucker at both their extremities. They constitute two families; viz. the *Hirudinidæ*, or leeches, the body of which is wholly unfurnished with appendages, and these form two tribes; the *Albionnides*, in which the oral sucker is but of one piece, and is separated from the body by a constriction,—its orifice being evidently longitudinal. Here he places the genus *Pontobdella*, the species of which are natives of the ocean, and attach themselves chiefly to the chondropterygeous fishes, as the rays and sharks; and *Piscicola*, which inhabits fresh waters, and frequents carps and tench. The second tribe are the *Bdelleoïdes*, in which the sucker consists of several pieces, and is scarcely separate from the rest of the body. It has its aperture transverse, forming, as it were, two lips, the interior of which is drawn back. This tribe contains *Bdella*, *Hirudo*, *Erpobdella*, *Nephelys*, &c. — the most celebrated of which is the medicinal leech (*Hirudo*). They are all inhabitants of fresh water, and some die almost instantly on being withdrawn from it, whilst others will live out of it for a considerable time. Many of them are great enemies to the earth-worm (*Lumbricus*); whilst they themselves are preyed on by birds, fishes, and the aquatic larvæ of hexapod insects. The second family, or *Branchellionidæ*, which have the body furnished above with a double series of membranous foliaceous appendages is formed by the single genus *Branchellion*, the typical species of which attaches itself to the *Torpedo* in the Mediterranean.

(19.) The second large division of the group, th ANNELIDES CHÆTOPODES, is considerably the most numerous, and may be further separated into two subdivisions; viz. the *Annelides Cephalobranchiæ*, or *Tubicoles*, and the *Annelides Mesobranchiæ*. The former are without a head, eyes, or maxillæ, and the body is terminated anteriorly by a mouth. It is usually furnished with appendages, the whole or the majority of which are collected in front. It is also supplied with hooked or subulated setæ, which emanate from pediform tubercles, and which enable them to ascend or descend within their tubes. The majority can neither swim nor walk; and those which crawl upon the ground do so by the aid of their tentacula. These animals always reside in tubes, which are affixed to other substances, and which but few quit. Lamarck styled them sedentary, from this circumstance; but very many which he arranged in this division, from the animal being imperfectly known, have, with the progress of research, been discovered to belong to the gasteropodous mollusks, as *Magilis*, *Vermetus*, *Dentalium*, *Siliquaria*, &c.. the habitations of many of these animals are, consequently, very similar to those of the latter. The impervious nature of their tubular residences required that their respiratory apparatus should be collected at its orifice; and we therefore thus find their structure accommodating itself to their natural economy. Several of these creatures are gregarious, and their tubes then assume very much the appearance of honeycombs. The animals themselves are elongate and vermiform. They consist of several families; viz. the *Serpulidæ*, the *Amphitritidæ*, and the *Terebellidæ*, &c.: the latter reside in slight tubes, which are buried in the sand or concealed beneath stones. The *Amphitritidæ* are readily recognised by the golden setæ, arranged like the teeth of a comb, at their anterior extremity. The tube of the *Serpulidæ* is calcareous and convoluted; and the anterior extremity of their body is ornamented with a coronet of appendages resembling plumes disposed in the shape of a funnel. They contain many genera, as *Serpula*, *Sabella*, *Hermella*, *Pectinaria*, &c.

(20.) The ANNELIDES MESOBRANCHIÆ, which constitute the second subdivision of the *Annelides Chetopodes*, are distinguished by the body extending beyond the oral aperture; and it is usually terminated by a distinct head, frequently furnished with eyes and maxillæ; and they have either no appendages, or these are placed along the whole course of the body. They are separated into three families; viz. the *Terricoles*, the *Arenicoles*, and the *Errantes*, or *Cephalotæ*. The first of these have no dermal appendages; and have neither a very distinct head, eyes, antennæ, nor maxillæ; their body is cylindrical, attenuated at both extremities, and furnished with several rows of setæ, which serve them instead of legs; and they live either in humid earth, or in the mud. The *Lumbricus*, or earth-worm, is the best known example of this group, which consists of three tribes: the *Thalassamenidæ*, the *Lumbricidæ*, and the *Clymenidæ*. The first contains the genera *Thalassema* and *Sternapsis*; the second, *Naïs*, *Tubifex* and *Lumbricus*; and the third contains *Clymene*; which last makes an approach to the *Tubicoles*, on account of its fragile tube, formed of grains of sand and particles of shells, although its structural peculiarities agree better with this family.

(21.) The second family, the *Arenicoles*, consisting of the genera *Arenicola* and *Chetoptera*, have many characters in common with the preceding: these have, however, their branchiæ placed only on the middle of the body. Their structure is more simple than that of the *Errantes*,—to which, through the medium of the *Arioidæ*, consisting of the genera *Cirratulus*, *Ophelia*, *Aricia*, &c., they form the passage. They inhabit the sands of the ocean, at the depth of one or two feet; and they betray their retreat by the small convoluted *threads of sand* formed on the surface. Fishermen make great use of them to bait their hooks; and, when caught, they stain the fingers with a yellow liquid.

(22.) The third and last family, the *Errantes*, is the largest of all; they form several tribes, and consist of a multitude of genera. They are the most highly organised of the whole of this group; having a very distinct head, furnished with antennæ, eyes, and almost always a protractile proboscis armed with maxillæ: each ring of their body bears a pair of feet, the structure of which varies considerably,—sometimes placed on the back and the belly,—and each consisting of two tubercles; yet both are occasionally united, and their extremity is furnished with a pencil of setæ. When the feet are united, and form but one organ, they are generally furnished with a pair of cirrhi, or fleshy filiform appendages, at the base of which the branchiæ are seated. The setæ themselves, which decorate the feet, are usually rigid and retractile, and they then serve for locomotion and the defence of the animal; but they are also often very long and flexible, and cannot then be withdrawn into the body, but cover it like a dense fur. They walk and swim well; but usually dwell beneath stones, among shells, or buried in the sand. A mucus that exudes from them, frequently forms around them a sort of tubular case, which they inhabit, but which is of a less compact and solid structure than that observed in the *Tubicoles*; and besides, the animal has the power of quitting it to seek its food and prey. They are all marine animals. We will briefly enumerate the tribes they constitute, and the more conspicuous genera.

(23.) Those without cirrhi at the base of their feet form two tribes, each consisting of a single genus, *Perepates* and *Campontia*. Those which have their feet furnished with cirrhi, are the NEREIDÆ, which are very abundant upon our coasts. They have a slender elongate body, their legs are furnished with tubercles, and the proboscis is armed with two very strong mandibles. They comprise many genera; viz. *Glycera*, *Nephtys*, *Alciope*, *Nereis*, *Syllis*, *Phyllis*, *Hesione*, &c. The EUNICIDÆ resemble the latter in their general form; but their feet are furnished with long filaments springing from one stem, like the teeth of a comb. They comprise the genera *Œnone* and *Aglaura*, which have eight mandibles, and conceal the head beneath the first segment of the body: *Lycidice* and *Leodice* have seven mandibles, with the head free and porrect; and further, *Diopatra*, *Eunice*, &c. The AMPHINOMIDÆ are those whose branchiæ are very complicated,—being tufted or ramose,—and they are spread all over the body. They have no maxillæ. The genera they consist of are *Hiponoe*, *Euphrosyne*, *Amphynoma*, *Chloeia*. And, lastly, the APHRODITIDÆ, which are the most conspicuous of all: their body is oval, and fringed with long setæ glittering with the most brilliant metallic splendour; their back is furnished with large membranous plates like elytra, disposed alternately, and hidden beneath an arch of fur formed by a dense multitude of hairs, which spring, like the before-mentioned setæ, from the feet of the animal, and are placed alternately as far as the twenty-fifth pair. They comprise *Sigalion*, *Palmyra*, *Aphrodita*, &c. *Polynoe* closely approaches the *Aphroditæ* in their structure, but the latter are destitute of setæ. [(18—23.) W. E. Sh.]

(24.) Mr. MacLeay's is the last arrangement of the *Annelides* we shall notice: his definition of the whole class and of the chief groups will here be given in nearly his own words. These animals, he observes, differ from true (or rather typical) *Annulosa*, in being hermaphrodite, and in general red-blooded. They are soft, vermiform animals, of an articulated structure, and which form the immediate connection between such vertebrate animals as *Amphioxus* and *Myxine* among fish, and such annulose animals as *Porocephalus*, and other white-blooded *Vermes* as have the sexes distinct. He divides the whole into five principal groups:— 1. The *Nereidina*, or such as are free, having a distinct head, provided either with eyes, or antennæ, or with both. 2. *Serpulina*, the animals of which are sedentary, destitute of a head, but provided with eyes or antennæ. These two are considered the typical groups, and are distinguished by having their body provided with distinct feet. 3. The *Lumbricina* are animals without eyes or antennæ, having the body setigerous for locomotion, and the articulations distinct. 4. The *Nemertina*, which are aquatic animals, without eyes or antennæ, the body not externally setigerous, and the articulations indistinct. 5. and lastly, the *Hirudina* are animals provided generally with eyes, but not with antennæ: the body is not externally setigerous, but the articulations are distinct. To these definitions Mr. MacLeay has added the following observations on three of these groups, which are too valuable to be omitted. The *Nereidina* he considers as the most perfect in their structure of all the class, as they possess numerous organs, and have a distinct head, which is generally provided with eyes and antennæ: some of them, after the manner of the *Serpulina*, inhabit tubes, which tubes are membranaceous, and formed by a transudation from their body; but in general the *Nereidina* are naked, and they are always agile animals, freely moving about in search of their prey. In general appearance they are wonderfully like centipedes. 2. The *Serpulina* of our author are sedentary animals, without eyes or antennæ: they live in tubes, which are either a natural transudation of their body, of a membranaceous or calcareous substance, or their tubes are semifactitious, or, in other words, composed of an agglutination of particles of sand, or other small substances. The calcareous nature of the tube in some *Serpulina* is very advantageous for their preservation in a fossil state. 8. The *Nemertina* are white-blooded worms, like some of the *Hirudina*, or leeches: in this group, however, the character of articulation becomes most indistinct. Rudolphi has placed *Gordius* along with *Nemertes*; and if *Gordius* goes into the group of *Nemertina*, it is possible that *Iularia* may also. *Nemertes Borlasii* is a long black sea-worm, which is said to suck shellfish; and the articulations of its body become visible when it is contracted.*

(25.) Respecting the VERMES, or annulose worms, all we can state in this place is matter rather of opinion than of investigation. In a former volume†, we have felt no hesitation in considering a large portion of Cuvier's *Parenchymata* as belonging to the class of *Testacea*. We have been led to this determination from the analogy of Guilding's genus *Herpa* to that of *Planaria*; and from the latter animals crawling upon a disk-shaped belly, perfectly like the *Nudibranchia*, or the dories and tritons, all of which are universally considered as naked *Mollusca*. On the other hand, we should be disposed to place among the true *Vermes* all those in which the body, from being cylindrical, presents no vestige of a disk. Probably the greater part of the *Entozoa* of Rudolphi come under this head; they all live and propagate in the interior of others, and they are so various that almost every animal has its own particular parasite. In some of these, particularly in the order *Nematoïdea*, there are no perceptible joints, but the external skin is striated transversely: but as we ascend higher in the scale, these incipient indications of the annulose structure disappear, and the body, as in the whole family of the *Tænioïdea*, or tape-worms, is composed, as Cuvier justly says, of joints more or less distinctly marked; the whole being terminated at one extremity by a square head, hollowed by four small suckers, while the other is attenuated to a narrow point. True it is, that both

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* Note on the *Annelidæ*; Annals of Natural History, No. xvi. p. 385.

† Malacology, p. 37.

Rudolphi and Cuvier place the latter among the *Parenchymata*, simply because the body has slight indications of viscera; but the distinction is too vague, and we are by no means disposed to adopt the views of arrangement proposed by these two eminent zoologists. Of all the true *Vermes*, the *Filaria* is perhaps the most simple, and the genus *Tænia* the most complicated. It has been said by some writer, that the tape-worm should more properly be considered a compound animal; since, if the true head be severed from the body, another would spring up in its place: this may possibly be true, but it is doubtful, and the fact does not touch the case in question; the remaining portion is still divided into segments or flattened rings, and the animal, to all intents and purposes, is annulose. That beings so simply constructed, are intimately related to the *Annelides*, may be inferred from the fact that most authors include the *Gordius*, or hair-worm, with the latter, and the *Filaria*, or Guinea worm, with the former, or the *Nematoïdea*. This pest of hot climates is said to be very common, particularly on the African coast, where it insinuates itself under the skin of the natives, and is reputed to acquire the length of more than ten feet. In this manner it will continue to grow for several years, sometimes causing such intense agony as to produce convulsions in the unhappy sufferer. Its body is of the thickness of a very small quill; and when it shows itself externally, the whole must be gently drawn out, otherwise it breaks, and excruciating suffering is produced. The most typical of all the true *Vermes* are probably found in Cuvier's family of *Tænioïdea*, which includes all those intestinal animals in which the head is furnished with two or more suckers placed round its middle, the centre of which is either marked by a pore, or sometimes furnished with a little proboscis, which is either naked or armed with spines. It has been generally asserted, that the pores of the head are connected by canals or nerves which creep along the margin of the joints of the body: each of these joints has one or two pores, differently situated, which appear to be the orifices of ovaries; a clear proof, should such be the fact, that every tape-worm is not a compound, but a single animal. The common, or best known species, *Tænia lata*, is one of the most cruel enemies to mankind; it occasions excruciating agonies, and frequently produces death: it has been said to attain the incredible length of upwards of a hundred feet; but that of twenty appears much more likely. We need not dwell further on this class of animals, which appear to have been created as afflictions to the human race, and whose natural arrangement, although so much has been written upon their structure, appears to us to be involved in considerable obscurity. They form, indeed, a part of that varied chain in creation, which unites, by imperceptible and graduated links, the lovely and the disgusting — the inviting and the repulsive. But where there is so much to admire and to fascinate, the general reader, for whom our pages are chiefly intended, will turn from those creatures which prey upon his perishable body, that he may bestow more admiration on the varied hues and elegant forms of the butterfly — a fitting emblem of his own immortal soul.

(26.) The CIRRHIPEDES, better known by the familiar name of *Barnacles*, are, in many respects, the most imperfect of all the annulose animals. They are all marine, living in the ocean, and are attached to other bodies, as rocks, pieces of floating timber, the bottoms of vessels, and even to the backs of marine animals. Their number is but few, and their geographical range very wide. In general appearance, they have some resemblance both to limpets and to bivalve shells; and this probably induced Linnæus, in the infancy of science, to place them with the *Mollusca*, or shellfish, where they will still be found, even in modern Introductions to Conchology, under the division of multivalve shells! The resemblances, however, here alluded to, are but very slight, even in external appearance; while the true nature of the animal of a barnacle and of a shellfish, as M. Cuvier well observes, is "very different." The *Cirrhipedes*, in fact, are the testaceous or shelly *Annulosa*; that is, they *represent* the *Mollusca* in the circle of annulose animals. Hence the error of M. Cuvier (who so frequently confounded analogy and affinity), in placing them immediately after the true shellfish, although he justly observes that they have a sort of intermediate station between them and the *Articulata*; in other words, they are analogous to the former, and connected with the latter. The body and all the most vital parts of the barnacles are protected by shelly pieces or valves, which fit close to each other, with a single opening at the top, through which the animal protrudes its feet, and imbibes its nourishment; we say its feet, for such they really are, although they cannot be used as such for locomotion — the animal itself being fixed either by its shell, or by a flexible peduncle immoveable at the base. It was long imagined that the barnacles were produced either from eggs, which were glutinous, and so adhered to the substance on which the full-grown animal was afterwards found, or that they were viviparous, the female bringing forth the young alive, and depositing them in suitable situations. Very recently, however, a naturalist of our own country, Dr. Thompson, has made known the extraordinary fact, that these creatures undergo a metamorphosis no less surprising than that of perfect insects. This, of course, removes all doubts of the true station which the *Cirrhipedes* occupy in the natural system, and at once places them in the circle of *Annulosa*, even if the possession of articulated limbs were not sufficient to place them strictly within that circle.

(27.) The anatomical structure of these animals may be thus briefly stated: — The vital parts are enveloped in a mantle or tunic, which is covered externally by shelly plates, varying in number and shape; thus bearing a strong analogy to the *Dithyra*, or bivalve shell. That part which is called the head is merely a slight eminence, beneath which is a mouth furnished with lateral jaws. Unlike all other annulose animals, this part is not at one of the extremities; for those organs which are called the *feet*, are placed above the mouth, so that the latter, properly speaking, is placed nearly beneath the body: there are six of these feet-like organs on each side, each consisting of a short stem, which is then divided into two very long, jointed filaments, resembling the antennæ of insects, and fringed, especially at the end, with fine hairs: in front of these, is another, much longer and thicker, which Poli calls a species of proboscis, and which there is every reason to consider as analogous to that organ in quadrupeds. M. Cuvier, indeed, objects to this term, but leaves us quite in the dark as to its real use. Poli, whose authority is of the greatest weight, observes that the motion of the heart is distinctly visible.* To his invaluable work, and the memoirs of M. Cuvier, we must refer the scientific reader for further details; but the paper by sir Everard Home upon these animals † scarcely deserves his attention, being replete with errors. To Mr. Thompson's essay we shall presently return.

(28.) We shall not here attempt any natural arrangement of these animals, but merely notice them as they stand at present arranged in systems. The chief divisions which have been made are two; and these have been called families. The first contains those which are elevated upon a fleshy, flexible peduncle, and are the true barnacles; while the second is composed of such as are attached by their shells only, and are consequently sessile. Collectors generally call them acorn-shells. These primary divisions, however, are arbitrary. Among the true barnacles, or those provided with peduncles, we find some entirely covered by shelly plates; while others are either wholly destitute of such protection, or have them so small that they can scarcely be perceived. Others, again, have the peduncle entirely covered with shelly granules, so that the membranaceous skin can scarcely be seen; while a few, possessing the compressed shelly structure of this division, are completely sessile. In the second great division of sessile barnacles, we find modifications of form still more remarkable. Some are found affixed indiscriminately to marine objects, whether living or dead; others take up their habitation only upon corals; a few seem confined to the backs of turtle, while the genera *Tubicinella* and *Coronula* imbed themselves in the flesh on the back of whales. To Dr. Leach, more than to any other naturalist, are we indebted for the definitions of all these various groups which he has proposed as genera. Mr. Gray, we believe, has also illustrated their affinities; and Mr. G. B. Sowerby has figured very many in his *Genera of Shells*. On the Continent, Audouin, Wagner, and Burmeister have investigated them; and the latter indefatigable entomologist has confirmed the discoveries of Dr. Thompson.

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* Test. Sic. i. 18.

† Phil. Trans. lxxv. 410.

(29.) In regard to the habits of the *Cirrhipedes* generally, very little can be said. Destined to live in an element different from that assigned to man, they are seldom seen in their native haunts by the closet naturalist. With many opportunities, in early life, for studying them in a living state, we regret that other avocations prevented this from being more than partially done. There can be no doubt, however, that the *Cirrhipedes* are carnivorous animals, feeding upon those minute polypes which swarm in all parts of the ocean, although frequently invisible to the naked eye. During the leisure of a voyage across the Atlantic, we had once the opportunity of watching a bunch of pedunculated barnacles, taken from a piece of floating timber and placed in a bucket of sea water. After a short time, as if they wished to reconnoitre their new habitation, they gradually opened the orifice in front, and protruded their fringed arms about half way; and finding that no injury resulted, they projected the other half. In this position they were really beautiful, for the cirrhi formed the rays of an oblong flower-shaped cup, each filament being slightly curved inwards at the tip. We observed some little moving particles in the tub of sea water; and "ever and anon" our captive barnacles would instantaneously draw themselves into their shelly covering, as if they had captured their minute prey, and had retired to eat it. Now, this is precisely the mode of life pursued by all those sessile polypes, called animal flowers (*Actininæ*); nor can there be the least doubt that the feet of the *Cirrhipedes* are, in fact, used as their arms, wherewith to seize all those small marine animals which come within their reach.

(30.) The analogies of the *Cirrhipedes* are remarkably interesting. We have already shown that they represent the apodal reptiles. But it is truly wonderful how Nature, in this group of *Annulosa*, has contrived to represent the fissirostral type among birds, of which the flycatchers are well known examples. These birds, in fact, are the most sedentary of their class; that is, they make little or no use of their feet, but as mere supports to their body, for they neither climb, run, nor even walk. It is the peculiar property, also, of these birds, to sit for hours upon the same twig, almost immoveable, watching for such passing insects as come within the reach of a sudden dart: while thus stationed, they are, in fact, as sedentary as the *Cirrhipedes*, and for the time may be said to be fixed to the station they have selected. The proof of an analogy being *natural*, is by comparing the two circles of which the particular groups under consideration form a part: thus, if we look to the order *Insessores*, or perching birds, and to the circle of the *Annulosa*, we find they represent each other in the following manner:—

Analogies of the CIRRHIPEDES *to the* FISSIROSTRAL BIRDS.

Classes of the *Annulosa.*	*Analogies.*	Tribes of *Perching Birds.*
APTERA.	Eminently carnivorous; sub-typical.	DENTIROSTRES.
PTILOTA.	The most typical in perfection of structure.	CONIROSTRES.
ANNELIDES.	Ornamental appendages to the head.	SCANSORES.
VERMES.	Feed upon juices.	TENUIROSTRES.
CIRRHIPEDES	Carnivorous; watch for their prey; locomotion imperfect, or none.	FISSIROSTRES.

The regularity with which the groups in each of these columns follow each other in absolute affinity, and thereby form two circles, is always one of the proofs that analogies are founded in nature. Perhaps the most singular representation which this table elicits, is that by which the worms (*Vermes*) typify the humming-birds (*Tenuirostres*). It is among the vermiform or tenuirostral types of the *Vertebrata*, that we always find those animals which have an unusually long and pointed snout — whether it is modified into the muzzle of a quadruped, or the bill of a bird; the mouth, also, is invariably small. Now, this character, under a new appearance, shows itself among the intestinal worms, which are the most pointed at their extremity of all the others; the mouth being so small as sometimes not to be visible. The suctorial birds, in like manner, have the longest bills, but the smallest mouth, in proportion to their size, of all the *Insessores;* and they live chiefly upon vegetable juices, while the worms live upon those of animals. It is the beauty of the theory of representation, that if once the natural series has been discovered, it receives new strength and demonstration from all other natural groups in the animal kingdom: so that the foregoing table is but a clue to a hundred others, which may be taken from those portions of the vertebrate and annulose kingdoms, which have been illustrated in this manner in our former volumes.

(31.) The resemblance of the barnacles to marine shellfish is so strong, that to this day they are confounded with them by collectors; while even Linnæus, from not being acquainted with the true structure of the animal, fell into the same error, and classed them with the *Mollusca*. Here, then, we have a strong instance of that principle which nature invariably acts upon in the construction of all her productions: we have one group of animals representing another; and this so completely, as to deceive both the learned and the ignorant. Now, the only way in which this popular association of the barnacles with the shelly *Testacea* can be clearly demonstrated, is, by comparing the two groups together, and applying to their component parts the test of analogy. Unfortunately, the natural series of the *Cirrhipedes* among themselves is unknown. There can be little doubt, however, that the sessile and the pedunculated divisions form the two typical groups; and these furnish us, of course, with the chief characters of the whole class. We can thus compare the primary divisions of the *Annulosa*, one of which is the *Cirrhipedes*, with the five great divisions of the animal kingdom, — the *Mollusca* being unlike any one of the latter. The following table shows these two series, with their divisions and analogies:—

Analogies of the ANIMAL KINGDOM *to the* ANNULOSA.

Series of the *Animal Kingdom.*	*Analogies.*	Series of the *Annulosa.*
VERTEBRATA.	Metamorphosis imperfect, or none.	APTERA.
ANNULOSA.	Metamorphosis perfect.	PTILOTA.
RADIATA.	Head indistinct, or none; body with radiating appendages.	
	Body simple, without members or appendages.	
MOLLUSCA.	Body protected by a shelly covering.	CIRRHIPEDES.

The most perfect vertebrate animals are, of course, the quadrupeds; and these, like the most perfect apterous insects, are destitute of wings. The possession, however, of those members, together with a complete metamorphosis, are the grand characteristics of the *Annulosa;* and more especially of the *Ptilota,* or winged insects. The analogy between the *Annelides* and the *Radiata* is remarkably strong; for the greater part of the former have their limbs or members radiating as from a common centre; they have all the outward appearance, in fact, of the *Radiata,* although their internal structure is widely different. The most simply constructed animals in creation are the *Acrita,* and the most simple of all *Annulosa* are the *Vermes.* So closely, indeed, do these two groups represent each other, that, in the present ignorance which pervades their history, we hardly know to which of these groups certain genera belong. Last of all we have the *Cirrhipedes,* with their shelly covering, representing the *Mollusca,* or shellfish; the grand characteristic of that class being the testaceous covering with which the whole body of the animal is protected. We allude, of course, to those groups of the *Mollusca* which stand at the head of the class, as the *Gasteropoda* and the *Dithyra,* and which take precedence above all the diversified animals which form the aberrant groups, scarcely any of which are testaceous. We have already shown how erroneous are those conclusions which some writers have come to, respecting the little dependence that can be placed on characters drawn from empty shells; and we shall now venture to make the assertion, that, if these coverings did not exist in the typical groups of the *Mollusca,*—in other words, if no molluscous animals had shells,—we should at once pronounce the group to be artificial, because every analogy in nature shows that *one* of the aberrant types lives under the covering of some substance, generally harder than itself.

(32.) The *metamorphosis* of the *Cirrhipedes,* as we have before intimated, was first made known by Dr.

Thompson. It is unquestionably one of the most important discoveries in modern science, and, in the "flood of light" which it has thrown on the whole natural arrangement of invertebrate animals, is fully equal to that made by Trembley on the nature of the polype. As we have had no opportunity, ourselves, of verifying the facts disclosed by our author, we shall give them to the reader in his own words. On the evening of April 28. 1823, on the coast of Ireland, near Cork, Mr. Thompson captured, in a small muslin towing-net, a number of minute marine animals, among which was one which he considered as a nondescript. "This was a small translucent animal, $\frac{1}{10}$th of an inch long, of a somewhat elliptical form, but very slightly compressed laterally, and of a brownish tint. When in a state of perfect repose, it resembles a very minute muscle, and lies upon one of its sides at the bottom of the vessel of sea water in which it is placed: at this time all the members of the animal are withdrawn within the shell, which appears to be composed of two valves united by a hinge along the upper part of the back, and capable of opening from one end to the other along the front, to give occasional exit to the limbs. These limbs are of two descriptions; viz., anteriorly, a large and very strong pair, provided with a cup-like sucker and hooks, serving solely to attach the animal to rocks, stones, &c.; and posteriorly, a pair of natatory members, articulated in such a manner as to act in concert, and to give a very forcible stroke to the water, so as to cause the animal, when swimming, to advance by a succession of bounds, after the same manner as the water-flea (*Daphnia*) and other *Monoculi*, but particularly *Cyclops*, whose swimming feet are extremely analogous. The tail, which is usually bent up under the belly, is extremely short, composed of two joints, and terminates in four setæ; and it is employed to assist in progression, and in changing the position from a state of repose. The greatest peculiarity, however, in the structure of this animal, is its eyes, which, although constantly shielded by the valves of the shell, are pedunculated, as in the crab and lobster, and placed anteriorly at the sides of the body. Any naturalist acquainted with the *Crustacea*, on reading this short description, will readily assent to what has been advanced as to the very extraordinary and anomalous character of this little animal, and to the dislocations it seems calculated to produce in our classifications. But for its pair of pedunculated eyes, it would find place as a new genus of the bivalve *Monoculi* (*Ostracoda*); its members approximate it to *Argulus* on the one hand, and to *Cyclops* on the other, — genera which are widely separated; while its eyes show its relation to the crabs, lobsters, and other decapodous *Crustacea*. Reflecting upon these circumstances, on their great abundance during the early part of spring alone, and their presenting no variation indicative of a difference of sex, induced a belief that they were the larvæ of some crustaceous animal." With these impressions, our author procured some more of these creatures in the spring of 1826; "and in order to see what changes they might undergo, they were kept in a glass vessel, covered by such a depth of sea water, that they could be examined at any time by means of a common magnifying glass. They were taken May 1st; and on the night of the 8th, the author had the satisfaction to find that two of them had thrown off their exuvia, and, wonderful to say, were firmly adhering to the bottom of the vessel, — changed into young barnacles! such as are usually seen, of *Balanus pusillus* Pen., intermixed with grown specimens on rocks and stones at this season. In this stage, the sutures between the valves of the shell and of the operculum were visible, and the movements of the arms of the animal within,—although these last were not yet completely developed: the eyes, also, were still perceptible, although the principal part of the black colouring matter appeared to have been thrown off with the exuvium. On the tenth day, another individual was seen in the very act of throwing off its shell, and attaching itself, like the others, to the bottom of the glass. It only remains to state, that as the secretion of calcareous matter goes on in the compartments destined for the valves of the shelly covering, the eyes gradually disappear, from the increased opacity thence produced, and the visual ray is extinguished for the remainder of the animal's life: the arms at the same time acquire their usual ciliated appearance. Thus then," continues our author, "an animal originally natatory and locomotive, provided at the same time with a distinct organ for sight, becomes permanently and immoveably fixed, and its optic apparatus obliterated."[*] The relation which the above extraordinary discovery establishes between the *Cirrhipedes* and the *Crustacea* is so intimate, that Mr. Thompson, as will subsequently appear, considers both as belonging to one class. We trust this indefatigable and acute naturalist will himself prosecute the interesting discovery here detailed, where he now resides[†]: he has opened a vast field for research, as new as it is important. We have yet to learn the metamorphosis of the pedunculated and diadem barnacles, the larvæ of which must have many peculiarities. The few numbers of this gentleman's *Zoological Researches*, which have yet appeared, are filled with new and important facts regarding the minute inhabitants of the ocean, scarcely inferior in importance to that which we have here detailed.[‡]

(33.) To illustrate the foregoing facts, we must refer to Mr. Thompson's figures and explanations, which will make the reader better acquainted with the above description of the young barnacle. The natural size is not larger than a grain of cress seed. When magnified, and viewed from above, the turgid appearance of the valves is seen, and also an elbow of the anterior members of the animal, the tail part being the narrowest. When the animal is very highly magnified, and all its parts seen, its limbs are protruded from the anterior opening of the valves: these consist of the two fore feet, which have a peculiar position when they are extended by the animal, in order to fix itself by means of the sucker and claw at the end: a fourth large basal joint remains concealed by the shell; towards the other extremity of which, and placed beneath, are six pairs of swimming legs, used in the manner of oars to propel the animal forward. At the extremity of the tail are two, short, setiform appendages, which no doubt act as a rudder. The appearance of the eye, as seen through the shell, gives an inaccurate idea of its form; but, when highly magnified, its pedunculated shape clearly appears. There is an appearance on the back of the shell, which Mr. Thompson considers as the presumed nucleus of future attachment. The tail, when highly magnified, is seen to consist of two articulations, from which spring four setæ, or bristles,—two being shorter than the others: the swimming feet, also, when very highly magnified, are then seen to consist of two divisions, — the shortest of which is that which comes nearest the body: these are the organs, in fact, which are changed into the cirrhi of the barnacle. The natural size of the animal, after its metamorphosis into a barnacle, is not larger than that of the larva state. When highly magnified, the rudiments of the eyes can still be traced through the large valves of the operculum, and the enclosed animal is still seen through the central opening of the operculum. The valves of the body of the shell are marked, as before observed, by distinct sutures. When viewed in profile, the arms, or cirrhi, if protruded, become more conspicuous. One of these cirrhi, upon being very highly magnified, although much jointed, did not at first exhibit any appearance of fringed hairs. The full-grown barnacle is seldom more than half an inch long: when viewed in front, the six pieces composing the shell are distinctly seen; but in profile, there appear only four. Besides the metamorphosis above described, the *Cirrhipedes* cast or moult the outer covering of their soft parts, in the manner of the crabs. One of these exuvia, with its various details, will be found on the tenth plate of Mr. Thompson's Memoirs, to which we must refer the reader.

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[*] Zool. Researches, No. iii. p. 76.

[†] Dr. Thompson holds a high medical appointment in New South Wales.

[‡] Mr. Westwood, on the strength of his observations upon the "Egg of one of the West India Land Crabs," calls in question the whole theory of Mr. Thompson; as if "the egg of a land crab" was sufficient to set aside a series of experiments such as these! Any tyro would have the same show of reason for denying that the *Lepidoptera* have four wings, because he may happen to find the female of a species which was apterous. See his *Classif. of Insects, Addenda* to vol. i.

(34.) Having now given the reader a general outline of those annulose classes, which lead from the typical groups to other and more distant forms of the animal world, we shall here introduce a few observations on the arrangement of true insects, previous to commencing their survey. By this plan, the grounds of our dissent from all preceding arrangements will be concentrated in one part of the volume, and much repetition of the same opinions will be prevented. If the principles upon which a classification is based are unsound, the superstructure of course must be erroneous, and need not be objected to in detail; and we shall arrange our remarks under two heads:—1. Regarding such systems as are merely framed upon the arbitrary opinion of their authors, who have attached a value to certain characters; and, 2. Such as have been founded upon a supposed mutual relation of their parts. The former are artificial, the latter natural, methods.

(35.) So much has been said upon these two modes of arrangement, under which all existing systems of Entomology will arrange themselves, that we shall merely in this place condense their definitions, as introductory to our subsequent remarks. On a former occasion*, we have considered all systems to be artificial, which are not grounded upon any universal principles of arrangement, which exhibit the animal series without plan or harmonious relation, and which disregard analogies and affinities. On the other hand, we shall consider those as natural systems, which involve any one or more of these considerations, and which, looking beyond the individual, attempts to ascertain its station in the scale of being, by pointing out the various relations which it holds to other objects.

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* Geography and Classification of Animals, p. 131.

(36.) Every system which arranges insects upon principles, which have no reference or application to other parts of the animal kingdom, is not only artificial, but viciously false; inasmuch as it is contrary to what we know of nature. There is, or there is not, some *plan* in the creation. None but a disbeliever in the infinite perfections of the DEITY would deny the first; for, where there is no plan, there can be no perfection: besides, such a denial would be disproved by the innumerable traces of a system of co-relationship in the different tribes of animals, manifest to all observing minds. To take one of these tribes, therefore, arrange it without any reference to the others, and then to proclaim that our arrangement is founded upon nature, is a manifest absurdity. It is not merely a violation of the first principles of philosophical reasoning, but is an outrage upon common sense. Such a system, in one sense, indeed, may be defended as natural, on the plea that its foundation is laid upon anatomical structure, or on other peculiarities either of organisation or habits. But this is nothing to the purpose; it reaches not our argument: for every system *must*, in the nature of things, be so founded. The question is, whether any arrangement of animals can possibly be natural, which is not based upon a comprehensive view of all. The answer to this is obvious. It is morally impossible it should be so. Applying this axiom to the various systems of Entomology which come under our present head, and which may be termed *isolated systems*, we should, upon no other grounds, reject them all, otherwise than as temporary substitutes for some other, however imperfect, which aimed at arranging all animals on a few general principles of classification. We should admit them to be *useful;* but deny that, by any possibility, they could be *natural.*

(37.) The consequences of naturalists forming systems for that portion of nature only to which they confine their studies, have been precisely what might be anticipated. Having little or no acquaintance with the innumerable groups of animals lying beyond the confines of those they study, they have not the knowledge requisite for enlarged generalisation. Destitute, therefore, of a solid foundation upon which their theories should be built, they lay a partial, and therefore an erroneous, one, founded only upon the objects immediately before them. Each, therefore, selects what he conceives to be the most important character, and makes it the corner stone of his system. In Entomology, for instance, one attaches a primary importance to the wings, and makes them the foundation of his theory; another objects to this, and chooses the legs; a third, differing from both, considers metamorphosis as the master key to the natural arrangement, and founds his arrangement thereon. No proofs, drawn from a general survey of all other animals, is required, or even thought of, to substantiate any of these theories: they merely rest on the individual opinion of their founders; and they are adopted or rejected according to the estimation in which their judgment may be held. Hence has originated the innumerable systems of Entomology which perplex the attention of the student, heap obstacles in the way of his advancement, and burthen our Introductions with complicated theories, and useless references. The judgment, or the imagination, of their authors being unshackled by any restraints, almost every one, ambitious of improving on his predecessor, makes some new change of his own. New denominations are given to old groups, and new foundations are laid for orders and classes. Every year brings forth a new theory, not of all animals, but of insects only, until entomological classification, having no foundation in inductive philosophy, is now become a quicksand, shifting with every tide that flows.

(38.) Independent, however, of the foregoing considerations, we should reject the systems just spoken of upon other equally strong grounds. The most obvious characteristic of the animal world is its interminable *variation.* A system, therefore, which is chiefly or exclusively built upon any one set of organs, must necessarily be artificial; since it presumes that to be fixed and determinate, which is not so in nature.* Who is to determine, *à priori,* whether the natural arrangement of insects rests on their metamorphosis, the presence or absence of wings, or the construction of their mouth? Each and all may be pronounced good and natural characters; but what reason is there that we should prefer one before the other, when we are altogether ignorant how these characters can be traced in other animals? The distinctions of the *Annulosa* rest not upon one, but upon many peculiarities of structure. And if we have no analogous instances or co-relations to guide our choice, that choice, to say the least, is liable to error. All, therefore, that can be said in defence of artificial systems is this,—that they are useful helps for the determination of species, and served the purposes of arrangement so long as no better methods of exhibiting nature existed. They have now lasted their time; and after doing ample justice to their authors for contributing to call forth better views, their systems, in modern classifications, may be fairly dismissed.

(39.) We now turn to natural systems, or those which have been framed on the admission that the different tribes of insects possess direct relations of analogy among themselves. There are more than one of these, all originating, however, in the philosophic researches of the author of the *Horæ Entomologicæ.* We are obliged, however, to dissent from all these,—not from objecting to the abstract principles upon which they are founded, but because they have not been extended sufficiently wide to carry a conviction of their accuracy: they stop short at that point, which, if carried, would insure demonstrative certainty. It is not to the principles themselves, but to the application of those principles, that we object. If the system of Clairville—which owes all its celebrity to the use it has been turned to—is really the foundation of the natural arrangement of insects, and is that by which the primary groups are to be regulated, why have not their analogies in other classes been pointed out? If the two typical classes of *Mandibulata* and *Haustellata* are really natural, then they would exhibit not merely mutual relations to each other, but equally so with all the vertebrate animals—nay, with all the primary groups of the animal kingdom. Hitherto, no one has attempted to do this. Neither these, nor the other supposed groups in the *Annulosa*, have ever been brought to this test,—a test, however, which is imperatively demanded for all groups supposed to be natural. Looking, therefore, to this deficiency of proof, and to the admission by the advocates of this system, that they are not even prepared to state which is the typical form of the *Annulosa*, we trust, upon these grounds only, that we may be pardoned for not adopting it. Gladly should we have done so, for we should then have been saved an immensity of research, and have been spared the necessity of disturbing those ideas on the higher groups of entomology, which are now so prevalent.

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* Of this description are those called the *Metamorphotic*, the *Cibarian*, and the *Alary* systems. The theory of the *Eclectic* system, which professes to be founded on the entire characters of insects in all their stages, is sound, did it not contemplate insects as unrelated to other animals. Those who wish to understand these and numerous other systems, may consult the fourth volume of Kirby and Spence, or Mr. Westwood's *Introduction to the Modern Classification of Insects.*

(40.) It is an easy matter, indeed, to raise innumerable *small* objections against every natural system, whether founded upon the theory we have just been speaking of, or upon that which we here promulgate; but these will always occur, while natural classification, as at present, is in its infancy. On these, therefore, we have not touched; we have directed our remarks, not to such comparatively trivial matters, but to the ground-work of the system itself. We have long held and expressed the opinion, that the comparative rank of circular groups is just as definite, and is just as real, in nature, as the difference between species and species. In such groups, indeed, there will always be gradations, by which Nature glides from one into the other; and this change is almost so imperceptible, that it is nearly impossible to say where one terminates and the other begins. Nevertheless, in the most intricate cases, we hold the distinction to be definite, and therefore absolute. According to the predominance of characters, having relation to two different groups, which an insect exhibits, so are we to determine its relative station in the scale of being. It may, indeed, sometimes happen, that the balance turns on almost an incalculably minute excess of the preponderating quality; but even that is quite sufficient to serve our purpose: on the other hand, if the balance is absolutely equal, we regard the subject as presenting that point of union which connects one group to the other: each, then, is definite; for, so soon as we arrive at that point of the series where its distinguishing marks disappear, we quit its limits, and enter those of another.

(41.) We may conclude this chapter by answering an interrogation, which the student may fairly put to us. What is an insect? To this we would reply, Any creeping thing which has jointed legs. This question, which the modern changes—for we cannot call them improvements—have involved in much technical obscurity (unintelligible to all but the initiated), is thus simply answered, because it really and truly expresses the very essence of our theory. In proportion, however, to the diversity of objects contained in all aberrant groups, so will be the difficulty of a precise definition. Thus, if the question related to annulose animals generally, the answer of — Every animal having joints to its body — must be received under a few limitations; since, in the very lowest of these, as in the hair-worms, and some others, no joints are to be distinguished. In respect to the two typical groups, we should term the *Aptera* or wingless the sub-typical, and the typical the true or four-winged insects; although the *Diptera*, which enter within the confines of the *Aptera*, are really possessed of two wings.

PART II.

ON THE WINGED INSECTS.

CHAP. I.

ON THE PTILOTA, OR FOUR-WINGED INSECTS IN GENERAL, THE CHARACTERS OF THE FIVE ORDERS, AND THEIR MUTUAL RELATIONS TO OTHER ANIMALS. — THE METAMORPHOSES OF INSECTS.

(42.) ALL insects, without any exception, possessing four wings, enter into one or other of the orders composing the *Ptilota*, a class first instituted by Aristotle, and adopted by us, as the first and foremost of the annulose animals. We have already shown, that as the possession of wings is the primary distinction of one of the great divisions of the vertebrate animals, so the highest development of these members among the *Ptilota* points them out as the pre-eminent types of the *Annulosa*. This is their primary distinction; and it pervades nearly every genus. Sometimes, indeed, we meet with a few examples of apterous insects; but these are only instances of those exceptions which occur in every natural group, and are hardly worth mentioning in a general definition. The *Ptilota* possess some other characters, not indeed altogether peculiar to themselves, but yet more striking and universal among them than in the apterous orders. They exhibit, collectively, the most perfect instances of metamorphosis; their legs are never more than six, and the head is always distinct from the body. Were we to descend to other definitions of the class, we should be so encumbered with exceptions, that the student would be perplexed, and the general reader wearied. We shall, therefore, at once proceed to define the orders, and explain their analogies, and adduce proofs in support of this theory of their arrangement.

(43.) The following are the five primary divisions, or orders, composing the class before us; these were all well known to the Ancients, and were adopted from them by the great naturalist of Sweden.— 1. The *Lepidoptera,* having the four wings highly developed and covered with imbricated scales, as in the butterfly and moth; the metamorphosis is complete, since the pupa is quiescent; the perfect insect is without jaws, and lives by suction, the rostrum or proboscis being spirally coiled.—2. The *Hemiptera,* where the upper wings are harder than the lower, generally coriaceous and folded; the metamorphosis is incomplete, because the pupa is active; the perfect insect, as in the last order, is without jaws, and lives by suction only; but the rostrum is not spiral.—3. The *Hymenoptera,* in which the wings are never coriaceous, but usually hyaline, and marked with strong nerves; the mouth is furnished with strong jaws, and with a sheathed proboscis; and the tail is usually armed with a sting. — 4. The *Coleoptera,* or beetles, where the upper wings are metamorphosed, as it were, into two hard cases, protecting the under pair, which are alone organised for flight; the mouth is furnished with jaws, but destitute of any proboscis.—5. The *Neuroptera,* wherein the wings are reticulated; the mouth furnished with jaws, but no proboscis; and the body, as in the dragon fly, without any sting.

(44.) It will be our object, hereafter, to show that these five orders constitute a circular group; in the mean time, we shall at once throw them into the following table: —

Analogies of the Five Orders of the PTILOTA.

Orders of the *Ptilota.*	*Analogies*	Classes of the *Vertebrata*
LEPIDOPTERA	Wings highly developed	BIRDS.
HEMIPTERA	Wings imperfect, or none	QUADRUPEDS.
HYMENOPTERA	Tail often armed with a sting	REPTILES.
COLEOPTERA	Most imperfect of their respective circles	AMPHIBIANS.
NEUROPTERA	Pre-eminently aquatic	FISHES.

(45.) When groups so widely dissimilar as these are brought into comparison, their analogies, of necessity, are proportionably faint. Nevertheless, as they strictly follow each other in the order of affinity, some degree of interest attaches to them. The type of imperfection among the *Ptilota,* in reference to flight, is certainly the coleopterous order, just as the amphibians are the most imperfect of the vertebrate series. The dragon flies, again, which stand at the head of the *Neuroptera,* are universally aquatic in their larva state, when they are as great lovers of water as fishes are among the *Vertebrata.* The poisonous stings of the typical *Hymenoptera* are analogous to those of several serpents, which not only have poisonous fangs, but actual stings at the extremity of their tail. The analogies of the *Hemiptera* to quadrupeds are altogether obscure, at least so far as we can discover: but this is amply made up by the striking relation of butterflies to birds. The reader of our former volumes is, by this time, fully aware that these tables of analogies are never equally striking in all their parts,—some being strong, while others are faint. In such cases, we either fall back upon our affinities, or bring the series to other tests. This latter plan we shall subsequently have recourse to, when comparing these orders with those of the apterous class.

(46.) The position we have assigned to the order *Hymenoptera* is that, however, of the greatest interest, not merely as regards its situation among the *Ptilota,* but its analogies to other animals. Singular as it may appear, there is no tribe of insects which—like the ox, sheep, and other hoofed quadrupeds—can be termed absolutely domestic, or capable of administering, in a direct way, to the wants of man. And yet a little consideration will show us there are many strong points of analogy between the ruminating quadrupeds and the bees: both are the most gregarious of their respective classes: the elephant in one, and the hive bee in the other, show us the highest development of instinct in the animal creation; and if the latter does not spontaneously yield us its honey, it will yet inhabit those artificial mansions we prepare for securing its sweets; so that, in some degree, it may be said to be not only a social, but a somewhat domesticated, insect. Now, to show that these facts have an immediate reference to our theory of representation, we shall here place the two series of these animals in juxtaposition.

Analogies of the PTILOTA *to the Orders of* QUADRUPEDS.

Classes of the *Ptilota.*	*Analogies.*	Orders of *Quadrupeds.*
LEPIDOPTERA.	Pre-eminently typical. Herbivorous.	QUADRUMANA.
HEMIPTERA.	Sub-typical. Carnivorous.	FERÆ.
HYMENOPTERA.	Gregarious; social and intelligent.	UNGULATA.*
COLEOPTERA.	Pre-eminently gnawers.	GLIRES.
NEUROPTERA.	Aquatic. Head very large.	CETACEA.

It is not a little singular, that this set of analogies is actually more determinate than that we have just noticed. The peculiar character of the *Hemiptera*, which is, that of being the raptorial type of the *Ptilota*, did not there appear; here, however, it comes into play, and makes up for the obscurity of the analogy in the last table. Our chief object, however, on the present occasion, is to confirm what has just been said on the relations of the *Hymenoptera* to the *Ungulata*; the bees being in one, and the elephant and horned cattle in the other. Beetles and mice, again, are the most gnawing of all the groups here named, and they are likewise the most aberrant of their respective circles. The disproportionately large head of the dragon flies, which are the types of the *Neuroptera*, find their counterparts in the whales and other *Cetacea;* both also are eminently aquatic. We shall not, for the present, pursue the subject further, since enough has now been said on the external* analogies of the *Ptilota*, to establish their relations to the vertebrate groups. How far these will be manifested among the apterous class will appear in the sequel.

(47.) *Metamorphosis*, as we have already shown, may be termed the chief philosophic distinction of the annulose animals; although, as it is a peculiarity which is neither permanent, nor can be detected at all times by the eye, it is not so convenient for popular use as those characters drawn from the external structure of the body. Now, this metamorphosis, or change of form, is produced by exactly the same general process as that which is usually termed *ecdysis*, or *moulting;* that is, the external skin or covering, at certain seasons or periods of growth, is thrown off, and the animal appears in a new one, which has been forming beneath. In both cases, a change in the outward covering is effected; but here the similarity ceases. When a quadruped, at the approach of summer, casts off by degrees the thick coat of hair or wool which Nature had given it to resist the cold of winter, the change, to a superficial observer, is scarcely perceptible; the new hairs are of the same colour, and nearly of the same texture, as the old; still less do we see any change in the outward form: the same may be said of the generality of birds; although, in this class, nature evidently proceeds a step further in her transformations. Among the water fowl, for instance, particularly in the wading order, we see the summer plumage much more gay than that of the winter; and, in many cases, so very different, that the same species has not unfrequently been described under two different names. It is a most singular fact, also, that nearly all the families and genera which represent the wading birds,—that is, which are of the grallatorial type, are distinguished by the very remarkable difference they present in their summer and winter dress.* Correctly speaking, there are scarcely any birds which assume, at first, the plumage of maturity. The young of both sexes, in the first year, are invariably clothed in the colours of the female; and should those of the mature male differ greatly from the other sex, the distinction does not begin sooner than after the first moulting. The further we recede from the quadrupeds, or, in other words, from the typical perfection of vertebrate animals, the greater is the change produced by this surprising process of nature, until, upon coming to the amphibian reptiles, we find animals which, in their young state are fish, and in their adult state frogs. Seeing, then, that Nature has contrived so many modes of performing, or rather modifying, the same process, it becomes absolutely necessary to draw a distinction between *ecdysis*, or simple moulting, and *metamorphosis*, or transformation. The former change is almost exclusively confined to vertebrate animals, while the latter is as strongly characteristic of those which are annulose. Our own views of the difference between *ecdysis* and *metamorphosis* are, therefore, as follows:— The first is a simple casting off of the old skin, unaccompanied by the developement of any new members, or by any variation of form; these latter being always the consequence of *metamorphosis*, or transformation.

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* By *external* analogies, we mean such as relate to groups out of the circle of the *Annulosa*.

(48.) Of metamorphosis, however, there are various kinds, or modifications; and these may be arranged under the heads of *complete*, or perfect, and *incomplete*, or imperfect. Without entering on the abstruse and ingenious disquisitions that have been written by others on this subject, we shall consider all transformations or metamorphoses as *incomplete*, where the animal is *active* in all its changes. Instances of this are innumerable among the annulose animals; and, as we have just mentioned, is apparent in the amphibious reptiles, which are the lowest of the vertebrate class. Incomplete metamorphosis, again, is shown under various modifications. In some, it is confined to a simple increase in the number of the feet, as in the apterous *Myriapoda*, or *Centipedes*; in others, the whole appearance of the animal is changed, as in the frogs. In all these cases, however, the changes appear to be but two in number; namely, the perfect form being assumed immediately after that is lost, in which the animal emerged to life. The tadpole changes to the frog, without any intermediate stage of existence, or any intervening change of form: this is, therefore, the lowest, or most incomplete, sort of transformation; since the first, or larva state, merges immediately into the perfect creature, without the intermediate change of the pupa, or chrysalis. The extraordinary facts regarding the metamorphosis of the crabs, disclosed by Mr. Thompson, show that these animals, also, never undergo the pupa transformation, although their change is much more remarkable for the complete alteration effected in their external appearance.

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* The typical chatterers, or the *Ampelidæ*, are striking instances of this fact.

(49.) So soon, however, as we approach the winged insects,—among which, as being the typical perfection of annulose animals, we should expect to find metamorphosis in its highest developement,—then we see a *third* stage of existence added to the other two. The larva, before it becomes a perfect insect, changes into a pupa, or chrysalis; and we have thus a threefold transformation. Here, again, we find those minor variations by which that gradual progression which Nature delights in can be traced. At first, as among the grasshoppers, the larva and pupa are only to be known from the perfect insect by their want of wings; next, the pupa becomes inactive, but still retains something of the external form of the state it had previously lived in. It is here, then, that we may draw our imaginary line of demarcation between an incomplete and a complete transformation. When the several stages of an insect's life are marked by such a striking difference in their form, that they would not be recognised by an inexperienced observer as one and the same creature; when, moreover, there are three of these distinct changes, totally differing from each other, and the pupa becomes inactive; then the metamorphosis is complete. This, indeed, is obvious; for what change can possibly be greater than that of an active, voracious caterpillar, to a quiescent, almost inanimate chrysalis? or can the imagination conceive any thing more dissimilar than are these two, from the aërial butterfly, fluttering from flower to flower upon "rainbow-coloured wings," and living upon the nectar they contain? Assuredly, this is the most wonderful and the most complete transformation that the mind can conceive: did it rest upon evidence which could for a moment be questioned, it is so utterly repugnant to the course pursued by Nature in her other works, that human reason would reject the belief with disdain, as totally incredible, and only equalled by the Eastern fable of the transmigration of souls, or the metamorphosis of the ancient poets.

(50.) Naturalists have given names to all the variations and degrees of metamorphosis hitherto observed; and these we shall subsequently notice. Some writers have assigned four states to the insect world; but no egg can be stated to possess *life*, until its contents are quickened. The period that the egg or embryo is concealed in the matrix of the mother, may just as well be termed one of the stages of existence of an animal, as that in which it lies unformed and inert in the shape of an egg.* These considerations appear to confirm our proposition, that metamorphosis is the grand characteristic of the annulose animals; for, while very few others are subject to such transformation, we find this property almost universal among them. This truth could not fail to be perceived by nearly all the great naturalists of the last and present century;* but, contenting themselves with the simple fact, they seem to have neglected to draw from it the first and most natural inference,—namely, that those animals which exhibited these transformations most conspicuously, should, from that very circumstance, be considered the most typical group of the whole. Now, we have already seen that the highest developement of metamorphosis is chiefly, although, perhaps, not exclusively, found among lepidopterous insects; hence it follows, if our premises are correct, that this order is unquestionably the type of the whole of the *Annulosa*. This conclusion, however, does not appear to have struck even the acute entomologist, who has laid so much stress upon metamorphosis as to have declared it the keystone of the natural system. Such, indeed, it really is; but, like every other character, it may, and has been, repeatedly converted into the fabrication of artificial systems. It has been well and justly remarked, that "there is no principle of arrangement so good as not to become worse than useless by being applied improperly." * The systems of Swammerdam, Lister, and Ray in former periods, and of Latreille and others in our own days, may be cited as proofs of this assertion. Mr. MacLeay, perceiving this, has endeavoured to discover the *theory of variation* in the metamorphosis of the *Annulosa;* and having, as he imagined, succeeded in his research, he proceeded to make it the corner stone of his system. It is singular, however, that he should have overlooked one of the first objections which his ingenious results lie open to; for, after all his study, he confesses, with the candour of a truly great mind, the impossibility he finds in determining what insects constitute the perfection of the annulose circle. This difficulty, we think, has originated from his adopting the two great divisions of Clairville's *Haustellata* and *Mandibulata* as the basis of his theory.

(51.) On the variation of metamorphosis there is much to be said, and more to be discovered. The subject, however, is so abstruse, and encumbered with so many difficulties, that we must touch upon it very briefly. It has been well observed, that the variation of metamorphosis is only an index of the series of affinity, and not a principle by which the orders have been strictly circumscribed.* Our author, in another place†, proceeds to designate the orders of the masticating insects by that which he considers the natural principle of this variation: the different kinds of metamorphosis he enumerates, are four,—viz. 1. *Obtect*, or what we have termed perfect or complete, as in butterflies, &c., or the *Lepidoptera* and *Trichoptera*. 2. *Coarctate*, as in bees and flies (*Hymenoptera* and *Diptera*). 3. *Incomplete*, as in beetles and fleas (*Coleoptera* and *Aptera*); and 4. *Semicomplete*, as in bugs and grasshoppers (*Orthoptera* and *Hemiptera*). In his fifth groups, *Neuroptera* and *Homoptera*, he can discover no particularly prevalent sort of metamorphosis; he therefore considers it to be "various." Now, even upon this theory, if metamorphosis is the basis of the natural arrangement, it follows that the *Lepidoptera* and the *Trichoptera* are the types of the *Mandibulata* and *Haustellata:* since these are the only masticating and suctorial insects whose metamorphosis is obtect,—that is, thoroughly complete and perfect. To the first of these propositions we may readily subscribe; but what entomologist would ever think of placing the *Trichoptera* at the head of the *Mandibulata*, when, in fact, they are obviously at the very bottom of the scale.

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* Hor. Ent. p. 456.

(52.) Let us now proceed to a more particular inquiry on the different changes produced by this principle of transformation. The larva state is, therefore, clearly to be considered the first stage in the life of an insect. Linnæus, with happy application, adopted this name from the Latin word signifying a *mask;* justly considering that the real form of the insect, while it remained under this covering, was disguised, or *masked*. We have two vernacular terms corresponding to this, although by no means so expressive, and in themselves indefinite. The larvæ of butterflies, moths, and of lepidopterous insects generally, are called caterpillars; while those which are white, somewhat inactive, and are found either in the ground, or enclosed in other substances, bear the common

* Hor. Ent. p. 456.

† Ib. p. 410.

name of grubs or maggots. The vulgar, also, sometimes call these latter *worms;* but as this name implies an affinity (of which there is none) to the common earth-worm, and is likely, on other accounts, to lead to error, we shall not introduce it. In this period of their life, during which they eat voraciously, and cast their skins several times, they continue a longer or shorter period; some only a few days or weeks — others, several months or years. In very many instances, particularly among the *Coleoptera* and the *Neuroptera*, the period passed in the larva state is much longer than that which the insect enjoys when in adolescence. The food, also, which it then consumes, is much more substantial in its nature, and more abundant in quantity; nay, in some instances, this is the only period when food of any description is taken; or, at least, the mouth of some perfect insects are so small as to appear obsolete, and we may thence infer they take little or no nourishment. Every one knows how ravenously the common cabbage butterfly devours the leaves of our garden vegetables; and the appetite of the silkworm is equally voracious: but when these insects arrive at their perfect state, and are furnished with wings, the first is merely supported by a little honey sucked from a few flowers, while the silkworm moth will live for weeks in confinement, without food, and appear to die rather from the want of air and exercise than from starvation.

(53.) On the primary types of larva, — that is, the chief forms to which all their variations may be referred, — a good deal has been written, and much more remains for discovery. But — we hear the student exclaim — can it be possible that the system of representation, of which so much has been said, should be so universal, that vertebrate types can be traced among the larvæ of insects? and is it true that they follow each other in the same succession? The fact, however novel, we venture to affirm, is perfectly true. Besides, it is very clear that, unless such was actually the case, or, in other words, unless all the groups of the *Vertebrata* found their representatives among the *Annulosa*, our theory on the natural system would be but an idle speculation; and our first proposition — that one uniform plan reigned throughout nature — would be denied. That the reader, however, may have this remarkable fact brought before him, we shall first proceed to describe what, in our opinion, are the primary forms of larvæ, and the series in which they naturally stand; and we shall then test the whole by comparing them with the vertebrate series of forms as defined in our former volumes. As the larvæ of many natural groups in this class of animals are either unknown or imperfectly understood, we shall select those belonging to the diurnal butterflies (*Papilionidæ* Sw.); because they have more especiallly engaged the attention of entomologists; and because their forms, with a few exceptions, are the best known. At the same time, we wish it to be understood that the following remarks, so far as our own investigations have extended, are more or less applicable to the chief groups of the *Annulosa.*

(54.) It appears to us that nearly all larvæ may be referred to some one or other of the following types, we shall designate by these names: — 1. The *Iuliform*, or pre-eminently typical. 2. The *Raptorial*, or sub-typical. 3. The *Natatorial*, or *Anopluriform*. 4. The *Suctorial*, or *Vermiform*, called also the *Onisciform*: and, 5. The *Rasorial*, or *Thysanuriform*. The first two of these belong to the two typical groups, and the last three to the aberrant group. Let us now proceed to notice them more particularly in the same order.

(55.) The *Iuliform* type of larva stands at the head: it is so called because of its resemblance to those insects which constitute the perfection of apterous insects, and of which the common ringworm (*Iulus*), so frequent under stones and bark in this country, is a good example. Caterpillars of this type are always smooth; they have no horns or excrescences either upon their head or their skin: they possess no noxious quality; nor do they assume, when disturbed, any threatening attitude. The head is never immoderately large nor disproportionably small, but of a just proportion to the rest of their body. Their shape is invariably long, assimilating to the form of an *Iulus;* and they are always provided with feet, the body being cylindrical. Sometimes there is a little down upon their skin, but otherwise this part is invariably smooth. They never conceal themselves under any natural or artificial shelter when feeding, but roam about; yet they do not leap, nor do they ever frequent the water. It will be perceived that, in many respects, the distinctions of this type of larva are negative; yet such characters are just as good, and in many cases better, than those which are drawn from positive circumstances. The best examples we can name of the larva we have now described, will be those of the garden or cabbage butterflies: the swallow-tailed caterpillars also belong to this type, but are not so characteristic as the former.

(56.) The *Raptorial* type, in most groups, may be at once known by having its body covered either with pungent spines, or warty tubercles assuming the same shape. Although unable to inflict injury by their bite, these spines upon the surface of these caterpillars are almost always sharp, and very frequenly have the property of inflicting a pain and irritation much more severe than we experience in the sting of a nettle. They are, in fact, the *type of evil;* and they show this in a remarkable manner: if, as in some lepidopterous groups, although not in the diurnal butterflies, the body is undefended either by spines or tubercles, they have yet the extraordinary habit of assuming various threatening or terrific attitudes, in such a way as to intimidate the spectator, and make him believe that they have the power of inflicting upon him grievous bodily injury. Nay, still further to show that particular reference they bear to the noxious and ferocious among animals, and to the evil and reprobate part of mankind, when they change into chrysalis, they either bury themselves in the earth, as if that was their final home, or, if the change is effected in the open air, their heads are suspended *downwards;* whereas, in the pre-eminent or iuliform type, the metamorphosis is invariably performed in the open air; and in the typical diurnal butterflies, the head of the chrysalis is always pointed towards the skies, as intimating a joyful and happy change in its next transformation. But this wonderful analogy does not cease here; it is among the caterpillars of this type, and of this *type* only, that we find all those which feed upon noxious or deadly plants, — on hemlock, nightshade, nettles, and all such as, either for their poisonous or hurtful qualities, are shunned by mankind,—as fit emblems of evil and of mischief. It is almost needless to recapitulate the negative characters of this type: the body always lengthened and cylindrical, the head without any particular horns, spines, or excrescences, and of a moderate proportionable size: the other extremity of the animal, although obtuse, is never suddenly thickened; neither are there any tails, filaments, or pointed appendages at the end. All the caterpillars of the diurnal *Lepidoptera* belonging to this type, are spined or tuberculated; but in the next tribe, which includes the hawk-moths, or crepuscular *Lepidoptera* (*Sphingides* Sw.), the threatening attitudes are developed in lieu of the armed spines: in both, however, we find a large proportion feeding upon poisonous or noxious plants. The common white admirable butterfly, which lives upon the nettle; the painted lady, which, as a larva, devours thistles; and the splendid peacock butterfly, which feeds with the former; are all familiar examples of the type we have here indicated.

(57.) The third is the *Natatorial*, or *Anopluriform* type, so named because, in the higher and larger groups, the animals belonging to it either live in the water or frequent its vicinity: such aquatic creatures may therefore be said to be *enclosed* or *covered*, as it were, from the atmosphere, and live under shelter of another substance. Now, although none of the diurnal butterflies are either natatorial or in any degree aquatic, Nature has nevertheless preserved, in such as belong to this type, the strongest and most beautiful analogy to animals of such habits. The *Hesperidæ*, or skipper butterflies, unlike all others of the tribe, are *enclosed* and *covered*, in their larva state, from the air; not, indeed, in water, but within the folds of a leafy case, fabricated by the animal itself, and which it never quits except as a winged insect. The name of *anopluriform* had better, perhaps, be retained to the examples of this type among the diurnal *Lepidoptera*; this epithet having been bestowed upon it from the resemblance borne by the caterpillars to the anopluriform apterous insects, or bird lice, of Dr. Leach. But let us enumerate more particularly the character of these larvæ. First, then, the head, which in the two former is of moderate size, in this type is always disproportionably large, thick, and obtuse, yet it is never decorated with horns or appendages: the body is not long, but rather inclined to shortness; the hinder extremity, however, is always much thicker than the fore part, so that it frequently seems to end very abruptly: the surface is generally smooth and naked, nor is their any appearance of spines, tubercles, or other appendages. These caterpillars, more than any other, resemble the fat maggots of flies; while their bodies, being sufficiently protected by the covered habitation they fabricate, are usually soft: the legs are small and weak, because there is little use for them; the caterpillar being, as it were, sedentary. In the natatorial or anopluriform type of other animals, the legs are generally wanting.

(58.) The *Suctorial*, or *Vermiform* type, is one of the most remarkable types, in the variation of its structure, and in the apparently contradictory forms under which it appears. There is one peculiar distinction, however, by which it may generally be recognised; this is, in the smallness of the heads of these caterpillars, destitute, at the same time, of any thing like extraneous appendages. It follows, from this circumstance, that the mouth is particularly small; while the hinder extremity of the body is invariably narrow and pointed. These peculiarities are the very reverse of those of the larvæ belonging to the last type, and render this of very easy detection. It might be inferred from the term *vermiform*, that these larvæ are always of the lengthened shape of a worm, and that in the mode of taking their food they are suctorial; but neither of these inferences would be correct. These caterpillars are likened to the true earth-worms, because both their extremities are pointed, and because they are the representatives of those creatures among the diurnal *Lepidoptera*. Again, they are termed suctorial, because most of their corresponding types or representatives among other animals derive their food from suction alone, and are the most *toothless* of their respective groups. The different shapes which belong to the suctorial type among the diurnal butterflies, is the *onisciform*, or *chelonian*: in other words, its shape is intermediate between that of a wood-louse (*Oniscus* Lin.) and a chelonian reptile, or tortoise: the head and tail, indeed, are small and narrow; but the body is disproportionably broad, much depressed, and appears as if divided into plates like the shell on the back of a tortoise. Most of the butterflies belonging to this type are natives of the Tropics; but there is one division which is more particularly European, and which constitutes the genus *Polyommatus**, or, the *Blues* and *Coppers*, of English collectors.

(59.) The *Rasorial*, or *Thysanuriform*, caterpillars belong to the last type we have to notice; and they differ, in many striking peculiarities, from all that we have yet spoken of. In the general shape of their body, and in the proportionate size of their head, they assimilate to the iuliform and the raptorial types; but from both these they may be known by two characters. Either the head itself is armed with distinct spines, forming a sort of crest round the back part; or it seems divided into two parts by a deep notch, each portion being pointed: sometimes these points are so long as to resemble horns; in other examples they are very short, and hardly conspicuous; while in some few, although the hinder part of the head is pointed, it is not divided. The extremity of the body gives us another peculiarity: this part, also, terminates in two pointed processes, which, according to their length in different examples, either assume the appearance of tails, or of two little short spines. We have no very striking instances of these horned caterpillars among those of the European butterflies; but if the student meet with the larvæ of any of the brown meadow butterflies, forming the modern genus *Hipparchia*, he will have a very good idea of the general character of thysanuriform larvæ, the great developement of which is seen only in the large butterflies of Tropical America. A few words may be necessary in explanation of the names given to these caterpillars. They have been called *Thysanuriform*, under a belief (and we think the supposition is correct) that they represent the *Lepisma* or *Thysanura* of Dr. Leach; while, by terming them also *Rasorial*, we point out at once their unquestionable analogy to the rasorial birds.

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* Zool. Ill. ii. pl. 134.

(60.) Let us now compare these types of lepidopterous larvæ with the five great groups of birds and quadrupeds: the test of their accuracy will consist, of course, on the analogy by which each should mutually represent the other. We commence, then, with the iuliform type. The butterflies which proceed from caterpillars bearing this form, are well known to be the most perfect of the whole tribe. This is manifested by their possessing six perfect feet adapted for walking. Linnæus was well aware that the swallow-tailed butterflies were the princes of the diurnal *Lepidoptera*, for he places them at the head as the *Nobiles*, and names the species after the heroes of Greece and Troy. They are, in short, the most perfect of all butterflies, whether we regard their general structure, or the unrivalled beauty of their form and colouring. Now, this perfection, in like manner, belongs to the typical order of perchers among birds, and the *Quadrumana* or *Primates* among quadrupeds.* In each of these, the power of locomotion is most developed and complete; and the feet are consequently more perfectly formed for such purposes than in any other. If we look to the metamorphoses of the iuliform butterflies, the analogy is further strengthened. Their transformation is not merely complete, but nearly all change into chrysalis with the head directed upwards. To this remarkable fact, which is an essential part of the sublime instruction conveyed to us by these emblems of our own resurrection, we attach the greatest importance; and we accordingly find it to be one of the leading features of the most perfect sort of metamorphosis. The iuliform, or pre-eminent type of larva thus agrees with the pre-eminent orders of quadrupeds and of birds; all agreeing in being the most perfect of their kind. The raptorial type (called by some the *Scolopendriform*) is the next in succession. We have seen that there is a character of *evil* belonging to this type, even under the apparently harmless form of a caterpillar; and if any one should be inclined to term this fanciful, he would soon change his opinion upon handling one of the spined caterpillars of Brazil, the pain of which (caused by its poisonous spines) would cripple his fingers for many hours. Now, one of the great characters of all the examples of this type throughout nature, is to be less perfect in their construction than the last, but to be endowed with one advantage,—that of *strength*. Such a power, in fact, is inseparable from their nature. The falcons and vultures among birds, and the carnivorous beasts among the quadrupeds, being the most cruel and ferocious, are consequently stronger than any others. The same observation is applicable to the butterflies of this type; they are well known to be the strongest in make, and the most powerful in flight, of all the diurnal lepidoptera; while they show a marked inferiority to the iuliform butterflies, by having the two fore feet so short as to be incapable of being used in walking. The metamorphosis of these caterpillars has been already adverted to, and its peculiarity forms a part of the inferiority of their station when compared to that of the pre-eminent type: the head of the chrysalis is pointed downwards to the earth, symbolical that all types of evil "are of the earth—earthly;" in contradistinction to the upward direction of those pupæ of the last type, which are the symbols of perfection. Upon these grounds do we maintain, that, in all the stages of their existence, the two principal types of the diurnal butterflies are strictly analogous to those of the vertebrate animals: if any other proof was wanting, we need only rest our argument upon this. In quadrupeds and iuliform butterflies we have the greatest perfection of the feet; whereas in raptorial or scolopendriform butterflies, and in birds, Nature has evidently rendered these organs imperfect, and made their perfection to consist in superior powers of flight.

(61.) If we turn to the *aberrant* types of larvæ, or those which have been named the *Anopluriform*, the *Vermiform*, and the *Thysanuriform*, we shall find their analogies equally strong among the vertebrate animals. The enormous head of the Hesperian caterpillars, and their thick obtuse body, are strikingly conspicuous in the anopluriform quadrupeds, or the whales (*Cetacea*); in which order, the head is so disproportionably large as frequently to exceed the circumference of the body: the aquatic birds, in like manner, represent both; and although their bodies do not end so abruptly, yet they have the shortest tails of all the birds in existence. Next let us take the *vermiform* or onisciform larvæ; how strikingly do the caterpillars of the blue and copper butterflies (*Polyommatus* Lat.) resemble a little tortoise, with their small pointed head and tail, and their wide depressed body marked by lines resembling plates! If, again, we compare them to armadillos, the analogy is equally just and capable of demonstration; for the genus

Dasypus is a vermiform type, while it is almost the only one among quadrupeds, which, from being covered with bony plates, can be compared to the tortoises or chelonian reptiles. The smallness of the head and mouth in the vermiform caterpillars is very remarkable; and upon looking to quadrupeds and birds, we find that the *Glires*, or mice, the armadillos, and the wading tribes (*Grallatores*), have the smallest and most pointed muzzle, the narrowest gape, and the least mouth of all vertebrate animals. Now, the only difference between the general form of these tortoise-like caterpillars, and that of the common earth-worm, is this,—that in the former the body is excessively contracted, whereas in the latter it is excessively lengthened: the pointed extremities of the head and of the tail, in both animals, is a common character, which, as we have already seen, belongs to no other type of larvæ of insects or of vertebrate animals; this at once accounts for the excessive length of body possessed by all the gnawing quadrupeds (*Glires* Linn.), and by all the birds in the order of waders (*Grallatores*).

(62.) There now only remain the *Rasorial* or *Thysanuriform* caterpillars; and these, if the preceding views are correct, must of necessity represent the *Gallinaceæ*, or *Rasores*, among birds, and the horned cattle, or ruminants (*Ungulata*), among quadrupeds. Now, both of these groups of vertebrate animals, in their respective classes, are the only ones which have horns, crests, or pointed appendages on their heads. Look to the whole of the order *Ungulata*, and you will find the rhinoceros, with its horned snout, and the numerous families of deer and antelopes and oxen, all decorated in this manner: turn to the gallinaceous birds, and you will find nearly all the peacocks and pheasants ornamented either with conspicuous crests, or with little ear-like egrets; the different fowls with fleshy combs cresting their heads, and the front of the different Guinea hens armed with bony protuberances. These are but so many representations of rasorial or thysanuriform larvæ, the chief characteristic of which, as every experienced entomologist well knows, is the horn-like spines which crest the head, and give to them the aspect of ruminant caterpillars. But this is not the only mode by which Nature has clearly pointed out to us the harmony and simplicity of her fundamental laws. Thysanuriform larvæ are those only which have the body either terminating in two long filaments resembling tails*, or in two fleshy points, as in the caterpillars of our common meadow brown butterflies.† Now, if it be inquired, what are the birds which have the greatest developement of tail?—the merest tyro will name the peacocks, the pheasants, and all the typical gallinaceous birds, as possessing this member in its highest state of developement. The analogy of this order of birds, with that composed of the domesticated quadrupeds, long ago pointed out by Linnæus, is unquestionable; and we accordingly find that the horse, which stands at their head, has the most beautiful tail among quadrupeds. But an arrangement, it has well been said, if really *natural*, will stand any test: the most trivial, as well as what appears to be the most important circumstances, must be taken into consideration. Now, it is notorious, that the most bulky of true quadrupeds are found in the class *Ungulata;* there we have the elephant, the rhinoceros, the hippopotamus, and the whole family of antelopes and oxen: the largest birds, on the same principle, occur in the rasorial order; and in like manner the giants of the diurnal butterflies all proceed from the thysanuriform caterpillars. To pursue these beautiful and astonishing representations further,—for many others might be pointed out,—is surely needless. Enough has been said to establish our proposition, that the types of lepidopterous larvæ are only so many representations of the primary types among the most perfect of the vertebrate animals. This fact being demonstrated, it follows that all the larvæ of annulose animals must bear as true analogies to those of the diurnal *Lepidoptera*, as these latter do to the primary divisions of quadrupeds and of birds.

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* Merian's Ins. pl. 19. fig. 1.; Stoll, pl. 3. figs. 3, 4.
† See Lewin's Brit. Ins. pl. 17. to 24.

(63.) If, again, we look for analogies between the classes of the *Annulosa* and the typical forms of larvæ already explained, we shall not be altogether disappointed. It becomes, indeed, of the first importance to illustrate this subject, because, having abandoned all the arrangements and theories of our predecessors, the entomological world in general will expect that good and sufficient reasons should be urged for this venturous proceeding. We begin, then, with the iuliform type of caterpillars, which, as we have already seen, are the pre-eminent; and they accordingly produce the most perfectly organised of all the diurnal butterflies: it is consequently this type which represents and stands at the head of the class *Ptilota*. Next come the *Aptera*, and the raptorial larvæ. In the former we find all the different races of those noxious or disgusting insects which excite so much terror in vulgar minds, and whose very appearance is repulsive. Among these it is only necessary to mention the different races of spiders, wood lice, scorpions, centipedes, harvest bugs, bird lice, and those detestable parasites the *Acari*, which are the pest of man in tropical countries. Surely, if any assemblage of insects may be called types of *evil*, those in the list now before us are universally felt and known as such. They compose, consequently, the sub-typical group, whose hideous aspect and hurtful qualities are aptly represented by the forbidding appearance and the stinging qualities of the raptorial or scolopendriform type of caterpillars. These latter, among the diurnal *Lepidoptera*, produce the *Nymphalidæ*, the sub-typical group of the butterflies; and are again represented by the threatening rampant caterpillars of the sphinxes, which are also the sub-typical group of the lepidopterous order. Between all these, therefore, it is not possible to conceive a more beautiful series of representations. Now pass to the Rasorial or Thysanuriform type, the caterpillars of which, as Dr. Horsfield well observes, have their heads beset with horn-like processes; but "their chief characteristic," as he could not fail to observe, "consists in two very strongly marked lengthened, or filiform appendages" at the end of the abdomen. We have already seen that these tail-like processes represent the long tails of the rasorial birds; and we shall find that Nature again employs this favourite device to designate the rasorial type of the *Annulosa*. It is among the *Annelides* alone, of all the aberrant classes of annulose animals, that we find not a few, but the greatest portion, ornamented with fringed crests on the fore part of their body, and long tail-like processes at the other. Among the *Annelides*, also, we have the largest *Annulosa*; while the thysanuriform larvæ produce the largest of all butterflies. Other analogies might be pointed out; but the above are so strong, that there cannot be a doubt of the *Annelides* representing the thysanuriform caterpillars. Let us next compare the class of *Vermes*, comprising the intestinal worms, with the vermiform type of caterpillars. Here the analogy is no less interesting. The entomologist will recollect that the great distinction of these caterpillars is the attenuated or pointed form of its two extremities, so that at first sight it is not readily seen which is the head and which is the tail. Now, this is precisely the description of an intestinal worm, where the mouth, if it exists, is so small as to become obsolete: even minute inspection is necessary before we can determine at which end it is situated; so completely pointed and uniform are the two extremities. If it be urged, that the shape of the vermiform caterpillars of the diurnal *Lepidoptera* are broad and flat in the middle of their body, we have only to look to several of the *Vermes* for an exact representation of this shape. And if it be said, again, that there are no vermiform caterpillars having the long cylindrical body of the intestinal worms, the entomologist must be reminded of the larvæ of the Linnæan *Geometria*, now called the true moths (*Phalænides*), where we find the longest caterpillars in the whole order of *Lepidoptera ;* just as the *Vermes*, and their representatives, are the longest of all annulose animals. There now remains but one division in each group to be compared, and these are the Anopluriform caterpillars and the *Cirrhipedes*, or barnacles. These, it will be remembered, stand at the extreme confines of their own superior groups; the Hesperian butterflies being the last of the *Papiliones*, and the barnacles the last of the *Annulosa*. In such extreme groups, the analogies, also, are always the most remote ; nor can we expect to trace any thing in common, as regards absolute structure, between the form of an anopluriform caterpillar and barnacle : but when we reflect upon the habits of these two very dissimilar tribes, we are immediately struck with the beautiful method by which Nature has intended that they should represent each other. The "truly natural character," as Mr. MacLeay observes of the *Cirrhipedes*, "is that vegetative quality by which they are rendered incapable of locomotion ;" while it may with equal truth be said, that the most striking and universal peculiarity of anopluriform caterpillars consists in their always remaining, as it were, sedentary : they spin themselves up in a leaf, which (apparently at least) they never quit ; and in which they change into the pupa. So far, therefore, they have nearly as much of that "vegetative quality," when we compare them with all the other types of larvæ, as have the *Cirrhipedes*. Both, in short, are modifications of the apodal larvæ, and may be described as truly sedentary, or living in one place. We have intimated, that it would be almost impossible to discover the most remote analogy between the *form* of a barnacle and an anopluriform larva ; but there is a very curious coincidence in the general appearance of the two animals, which may be here mentioned. Any one who looks at an anopluriform caterpillar, must be struck by the excessive size of the head, — often broader than the body, from which it is so far removed, as to appear attached to it by a peduncle. Dr. Horsfield, therefore, justly characterised these larvæ as having "a very large head, *attached to the body by a long neck.*" Now, the *Cirrhipedes*, properly speaking, have no head; but that part of the animal which corresponds thereto, and where the mouth is situated, is elevated on a long fleshy slender peduncle; so that the thickest part of the creature is that where the mouth is situated. Such, in fact, is an anopluriform larva; the head, where the mouth is placed, is the thickest part of the animal; so that the figure of a pedunculated barnacle may be termed a rude sketch of that form which Nature developes more accurately in the larva of a *Hesperia*, and brings to the highest perfection in the quadrupeds, under the form of the *whale*, — that is, in the most perfect of all her groups. We make no apology to the reader for this apparent digression; for what can be more delightful than to trace the varied yet consistent operations of Nature through the endless diversity of forms she spreads before us. We have shown that the primary types of caterpillars represent the primary divisions of quadrupeds and of birds, and that these three important groups are again represented by the great divisions of *Annulosa.* It is impossible to believe that results, so uniformly consistent with each other, can be founded but on the true symbolical system of Nature. We hope, therefore, to have now demonstrated our original proposition; namely, that the groups of the *Annulosa* represent those of the *Vertebrata*, and that the principles of variation, in one and the other, are precisely the same. The following table, therefore, concentrates all we have said in this paragraph: —

Analogies of the LARVÆ *of the* LEPIDOPTERA *to the* ANNULOSA.

Classes of the *Annulosa.*	*Analogies.*	Primary Types of LARVÆ.
PTILOTA.	Pre-eminently typical; innoxious; and smooth.	*Iuliform.*
APTERA.	Hairy or spinous; often poisonous.	*Scolopendriform.*
CIRRIPEDES.	Head very large, attached by a narrow neck.	*Anopluriform.*
VERMES.	Both extremities pointed; head very small.	*Vermiform*, or *Onisciform.*
ANNELIDES.	Head armed with spines; body with tail-like appendages.	*Thysanuriform.*

(64.) Let us now inquire into the principle of variation that pervades each of the types of larvæ herein described. This demands our particular attention, because, as it appears to us, some erroneous ideas have been entertained on this subject. We have seen that, in one large group of insects, containing many hundreds, perhaps thousands, of species, there are five leading types or forms of caterpillars; and that these correspond, and follow each other, in the same order of succession as do the classes and orders of quadrupeds and of birds. But the student, any more than the professed entomologist, must not believe that *all* the thysanuriform larvæ, for instance, go in one of these five divisions; or that he is to class *all* the scolopendriform caterpillars together under another division. True it is, that by such an arrangement he would get a uniformity of the same-shaped caterpillars, and he might flatter himself with having discovered the true arrangement of the *Lepidoptera;* but when he looked to the butterflies which proceeded from his thysanuriform or his scolopendriform larvæ, he would find that, so far from exhibiting the regularity and affinity with each other, which, from looking only to their caterpillars, he had expected, he will be perfectly disappointed. But, to render this clear, let us state a case;—let us suppose, for instance, he had in his possession the five caterpillars here represented: he sees that they answer to our description of the thysanuriform type; and, as they have a very close resemblance to each other, he consequently concludes, with every show of reason, that they will produce pupæ and butterflies equally near, and equally resembling each other. He accordingly feeds them, and watches their transformation with great anxiety. The first, we will suppose, which changes into chrysalis, is that of *Podalirius Pompilius*,*, or the Javanese swallow-tail: he sees with surprise, that the chrysalis, instead of having its head suspended *downwards*, as in all the true thysanuriform types, has it in an *erect* position; while the butterfly, into which it is subsequently transformed, has six perfect legs, and turns out to be of the iuliform, or pre-eminent, type. Sadly perplexed at this, he traces the progress of another; this he conceives, from the length of its horns, to be more typical, and he consequently expects that it will produce him a perfect thysanuriform butterfly. But he is again baffled; it becomes transformed into the purple emperor,—a butterfly which belongs to the raptorial, or scolopendriform, division. Of two green caterpillars, which, from their similarity, seemed to belong to species of the same genus, one only becomes a true thysanuriform butterfly, the other changing to one of the scolopendriform types. Finally, he gets from a fifth, which closely resembles the last two, a decided species of *Hesperia*,—a butterfly totally different from all those which his collection of thysanuriform larvæ had produced. How, then, it may be asked, can we maintain that each of the great divisions of butterflies has a peculiarly shaped caterpillar; when we see, as in the foregoing instance, those which are called thysanuriform are scattered in every one of these divisions? This question brings us to the point we are to explain,—namely, the principle of their variation. It is, theoretically, as follows:—Every natural group of butterflies, either in their caterpillar or perfect state, contains *representations* of the primary types of larvæ, modified, however, in such a manner, as to indicate the *real* type to which they actually belong. Suppose, for instance, we take the iuliform butterflies, the most perfect of the diurnal *Lepidoptera;* now, although the types of this division perfectly agree with our definition, we nevertheless discover, as we proceed to the aberrant examples, that Nature so modifies them, that some assume the aspect and character of scolopendriform larvæ, others have the thysanuriform shape, and so on. So that, although the butterflies which stand at the head of the iuliform division, as being typical, have iuliform larvæ, yet that the group, taken as a whole, will contain analogical representations of all the other types of larvæ we have described. The scolopendriform butterflies (*Nymphalides* Sw.), in the very same manner, contain representations of iuliform, thysanuriform, vermiform, and anopluriform caterpillars, besides their own proper type, which is scolopendriform. This fact, which none of the modern lepidopterous writers appear to have perceived, has been so fully illustrated in a series of plates *, as to be placed beyond all reasonable doubt. No better argument, indeed, than this, can be urged against the prevalent but erroneous idea, that the natural arrangement of the *Lepidoptera,* or, in fact, of insects generally, entirely depends upon the form of their caterpillars. Our belief is, therefore, that, without a knowledge of the perfect insect, we should never be able to explain whether it was allied to any one particular type by affinity, or whether it only analogically represented it.

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* Zool. Ill. ii. pl. 105.

(65.) Most of the modifications under which the primary types of larvæ are in a manner disguised, will be easily comprehended by the foregoing remarks. Iuliform larvæ, as we have already said, are smooth; but sometimes they are covered with fleshy tubercles, as in the instance of that beautiful butterfly, *Polydorus Thoas.* Now, the whole structure of the perfect insect shows that it belongs to the iuliform butterfly; and the reason of its larva being disguised in the form of another type (for the spine-like tubercles on its body are merely soft processes) is, to show that the genus *Polydorus* represents the *Nymphalides*, or scolopendriform butterflies. Another iuliform larva has the body terminated by two little points, thereby denoting its representation of the thysanuriform caterpillars. Thus every natural group, not only of the diurnal butterflies, but—so far as we yet know—of the whole order *Lepidoptera*, contains representations of the primary forms of larvæ, following each other in a uniform series, and producing perfect insects whose structure harmonises with this theory.. Where natural groups are comparatively small, and pre-eminently typical, it sometimes occurs that *all* the larvæ are uniform, without any of the above modifications. We see a strong instance of this in the old genus *Pieris*, the most typical, according to our views, of all annulose animals. It is to this very circumstance we must attribute the fact of all the Pierian larvæ being iuliform. But, when groups are very extensive, we consequently find a greater variety of shape, of colour, and even of structure, in the perfect insects; and this extends also to their larvæ. The genus *Papilis* of Latreille, the very next after that of his *Pieris*, is a case in point. We ventured, some years ago, to break up this most natural group into minor subdivisions, because we found it contained iuliform, scolopendriform, thysanuriform, vermiform, and anopluriform larvæ, while the perfect insects produced from them imitated, in some way or other, each of the great divisions of the lepidopterous circle.

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* Zool. Ill. 2d series.

(66.) In orders where the metamorphosis is imperfect or incomplete, and the larvæ more or less represent the perfect insect, the analogies we have already detailed can nevertheless be traced. Thus, while the lepidopterous caterpillars live upon vegetables, the *Hemiptera*, in their typical example (*Reduviidæ*), are carnivorous: like all the raptorial types, these insects live by rapine, and suck the blood or juices of their victims. The aquatic, or anopluriform, type is seen in the active larvæ of the dragon-flies, in the neuropterous order.

(67.) We shall now briefly notice the shape and peculiarities of the perfect pupa, or chrysalis. It is without limbs, inactive, and so sluggish as to show no other signs of life than a slight degree of motion upon being disturbed. An insect in this state exhibits little or no indication either of the form it originally had, or that which it is destined to assume. Among the typical *Lepidoptera*, or, more properly, the butterflies, we find three distinct types of pupæ, all of which change into that state above the ground. The *first* of these chiefly belong to the iuliform division: its form is angulated, with both extremities pointed; the tail is fastened to some other substance, generally the tree upon which it fed as a caterpillar; while the body is kept in an erect position, with the head pointing upwards, by means of a transverse thread, which loops it across its breast. The *second* form is generally more angulated than the former, and not unfrequently ornamented with golden and other metallic colours; but it is attached in a very different manner; it has no transverse brace, because it hangs suspended in the air by the tail, so that the head is consequently directed downwards to the earth. The *third* kind of pupa is attached, like the first, both by the tail and by a transverse thread; but its position is generally horizontal, and it is always enclosed within a convoluted leaf, similar to the habitation which it lived in as a caterpillar. The skippers (*Hesperidæ*) are the only family of butterflies, at present known, which change into pupæ of this description. There is reason to think, however, that, even in this family, some considerable deviation from the above mode of attachment will hereafter be detected. Lewin[*] figures the pupa of the spotted skipper as enclosed in a slight web, "under cover of a leaf," but without the transverse brace or thread. With the metamorphoses, also, of the extensive family of *Erycinidæ*, we are but imperfectly acquainted, except so far as regards one solitary species, figured by Stoll. The pupa of the Apollo butterfly is also described as being enveloped within a leaf; but whether it be simply enclosed in a thin web, without a brace, similar to that of the spotted skipper, is uncertain. Should the figures of Lewin be correct, it follows that such unbraced pupæ will present us with a *fourth* variation among the butterflies; and this will be analogous to the pupæ of the spinning moths, or silkworms (*Bombycides*), subsequently noticed.

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[*] Brit. Ins. pl. 46. fig. 7.

(68.) But the typical forms of perfect *Pupæ* are not all to be found among the butterflies; and this shows us, by the way, that a system built upon this stage of an insect is not a whit more valuable than another which rests solely upon the caterpillar. Hitherto we have seen that these creatures perform their transformations in the same element as that in which they were born; but on entering among the crepuscular or twilight flying tribe (*Sphingides* Sw.), we find that the larvæ quit the air and hide themselves in the bowels of the earth, as if they "loved darkness better than light, because their *type* was evil." At the head of this tribe stands the death's-head moth (*Sphinx Atropos*), carrying upon him the "sign and seal" of the symbol which Nature has designed him to be. Upon the thorax of this extraordinary insect, which is the largest moth found in Europe, the figure of a human skull, the emblem of death and of the grave, is so distinctly stamped, that a casual observer might easily imagine it was the work of some cunning limner desirous to give an unnatural terror to the aspect of a really harmless insect. Now, the caterpillar of this forbidding creature, when it is about to undergo its transformation, penetrates to more than a foot deep into the earth; and all the true sphinges do the same; but Nature does not pass to these subterranean pupæ without many gradual modifications. Some of the hawk moths spin themselves a web on the surface of the ground, which is covered by leaves: others proceed a step further, and make use of particles of dirt in preference: next come a few who repose themselves in a little hollow grave, so that they hardly lie beneath the surface: succeeding species dig deeper and deeper, until we have the *Sphinx Atropos* as the type and perfection of subterranean pupæ. The greatest part of the night-moths (*Noctuides*) possess this metamorphosis, which may also be found in the aberrant examples of the other tribes of moths; but in the two first mentioned, the *Sphingides* and the *Noctuides*, it is most prevalent and typical. The most complicated sort of pupa, however, is that into which the silkworm tribe are changed; for here we have a surprising display of preparatory caution and industrious skill. It seems hardly necessary to describe in this place the pupa or cocoon of the common silkworm, or rather caterpillar, except to notice its general structure. There is a provident care in the preparations made by all insects of this tribe, which is very remarkable;—they envelope themselves in an oval compact ball of the most delicate threads of silk; these are drawn from their own bodies; and they contrive, in some unexplained stage of the operation, to affix the whole, externally, to a firm object. Now, this is evidently a very near approach to the same *form* of pupa as that which is so slightly developed in the skipper butterfly before alluded to; but the difference is this,—that in the silk-spinning caterpillars, the web or cocoon is so firm and compact as to resist the weather; whereas, in the other insect, the web is so thin that it can be seen through, and consequently requires the additional protection of a leaf or of some other substance. We may add, also, that in the former, the chrysalis is always thick, cylindrical, and obtuse, particularly at the head; while, in the latter, it always exhibits some appearance of angles, and the head is more or less pointed. The pupæ of the true moths (*Phalænides*) are mostly of this latter description; that is, they spin a thin and often almost transparent web, within the folds of a leaf, although the form of the chrysalis itself is like that of the silkworm. This, in fact, is the typical form of the pupæ among the true moths; but in this tribe we have representations of the terrestrial and several other types, although we find none of those which are so common among the diurnal butterflies. Such are the leading variations or the most remarkable differences at present known among the inactive pupæ of the typical order of annulose animals. But there is another modification which must here be noticed, because it comes under our definition of a *perfect* chrysalis; this is called *coarctate;* and is when the larva changes into a pupa so entirely covered with a thick crustaceous shell, as to assume the appearance of an oval egg, the surface of which is smooth and glossy, without, in most instances, exhibiting more than a slight indication of those joints, segments, or angles, which are seen in all the types before-mentioned. This sort of pupa is chiefly, if not exclusively, found in the order of *Diptera*, or of two-winged insects, and in that of the *Hymenoptera*, which includes the bees and wasps. MM. Kirby and Spence consider this as a "fifth kind of pupæ, which are not, as in other instances, excluded from the skin of the larvæ, but remain concealed *under it*, and were hence called by Linnæus *coarctate pupæ:* they may be termed, in common language, cased nymphs. The envelope of these is formed of the skin of the larva considerably altered in form and texture."*

(69.) Of *imperfect* pupæ, or such as are active, and resemble either the larva or the adult insect, there are various kinds. The name given by Linnæus to these semi-transformations, appears to us particularly objectionable: he called them *complete*,—thereby leading us to the erroneous supposition that they are the most complete or *perfect* examples of the pupa transformation; the fact being, that they are, in this respect, precisely the contrary: they not only greatly resemble the mature insect in form, but are equally capable of eating and moving. As these insects, however, cast their skins at stated periods, and undergo changes, though slight, in their external and internal conformation, they are justly regarded by all authors as undergoing metamorphosis, although of an imperfect kind. Now, these belong to two very different groups of annulose animals. In the one, composing the apterous division of Linnæus, there is no appearance of wings: these are his complete pupæ. The rest belong to the *Ptilota*, or winged group, and resemble the perfect insect in every thing but possessing wings, the rudiments of which only appear: these latter are called by some writers *semi-complete* pupæ; and this name may be retained, because it implies an intermediate state of metamorphosis, between the imperfect transformation of an apterous insect, and the perfect or complete one of a butterfly. The period during which insects remain in this state depends upon the species; some quit it in a few hours, others after some months, while not a few continue in it one or even two years.

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* Int. to Ent. i. 69.

(70.) Let us now look to the third and last state of an insect. We have traced this singular little being through the two preparatory stages of his existence: in the first, he is an inhabitant of the earth, in the second of the grave, and in the third he becomes a denizen of the air. Such, at least, is the life of those perfect, or winged, insects, which are typical of the grand division of animals now before us. The connection between these, and apterous or wingless tribes, is rendered gradual by the intervention of the dipterous flies, where the organs of flight are but two; whereas, in the perfect *Ptilota*, the wings are almost universally four. When an insect assumes its adult or perfect state, Linnæus termed it an *imago*, "because, having laid aside its mask, and cast off its swaddling bands, being no longer disguised or confined, or in any respect imperfect, it is now become a true representative or *image* of its species, and is qualified to fulfil the laws of nature in perpetuating its kind. As the power of flying constitutes the perfection of true insects, we accordingly find this in its highest state of developement in the lepidopterous order, where the wings are the largest, and the most adapted for rapidity of flight. From this point of perfection, Nature recedes on each side, as from a land-mark; until, by two different routes, she reaches the order *Coleoptera*, where she presents us with an immense assemblage of insects, having, indeed, four wings, but of which two are converted into cases or shells (*elytra*), which principally serve as mere protectors or shields to the single pair which are alone formed for flight. Hence it follows, that the beetles are the most imperfect fliers of the *Ptilota*, or true insects; while, to compensate for such a loss, they are the most expert *runners* of all the orders. On looking to the vertebrate animals, we find the same plan in their creation. No birds run so swiftly as the waders (*Grallatores*); and no quadrupeds, in reference to their size, pass over an extent of ground so swiftly as do the rabbits, the hares, and other types of the order *Glires*. How beautifully does Nature thus adhere to her primary laws, while she modifies them in the most surprising manner. We shall now terminate our remarks on the metamorphoses of insects, or rather, of those two great divisions which constitute the types of the *Annulosa*.

CHAP. II.

THE LEPIDOPTERA.

(71.) THE order *Lepidoptera*, as being the most perfect of all insects, is that with which we commence our survey. It comprises the butterflies, the hawk moths, and the moths. The wonderful metamorphosis undergone by these insects, would be almost incredible, were it not familiarised to us from early childhood. That a crawling worm, ravenous of gross food, should voluntarily seek a retreat in the earth, or spin its own shroud,

—that then a change should come over it, so complete, as that not a lineament of its first form was retained,—that in this state, after remaining a misshaped lump, to all appearance inanimate, it should suddenly burst forth, full of life and joy, and with many-coloured wings ascend into mid air, and derive its only sustenance from the nectar of flowers;—all this, we say, is one of those miracles of nature, which, were it told of an insect that had never yet been seen, the world would not believe. But the world, alas! is absorbed in its own concerns; the things of time, in the minds of the million, exclude those of eternity. And although in this, as in numberless other instances, "Wisdom uttereth her voice in the streets, and crieth aloud,"—that voice is disregarded. A living emblem is placed before our eyes, of those changes which await Man: but by how few is it regarded! How few "lay it to their heart," and bring the momentous question to themselves—Is mine to be a change of happiness or of misery?

> And deems weak man the future promise vain,
> When *worms* can die and glorious rise again?

(72.) The general peculiarities of the *Lepidoptera* are so strongly marked, as to give to the whole group a very determinate character. It seems hardly necessary, in a work of this nature, to describe a form so universally known. As we must, however, enter into some particulars, we will take the common scarlet admirable butterfly as an explanatory type (*fig.* 1.), both of the larva or caterpillar (*a*), the pupa or chrysalis (*b*), and the imago or perfect state (*c*). The wings are four, broad, and ample, and rendered opake by a fine powder, which, upon being magnified, is found to consist of innumerable minute scales. The nourishment is imbibed by means of a long trunk or proboscis, which is spirally curved up when the insect is not feeding. The antennæ are long, composed of a vast number of very short minute joints, which frequently form a club-shaped mass at the end. The lower wings only, in some groups, are capable of being folded. The metamorphosis is complete; that is, the pupa is quiescent: some authors term it obtect, and others incomplete: this latter

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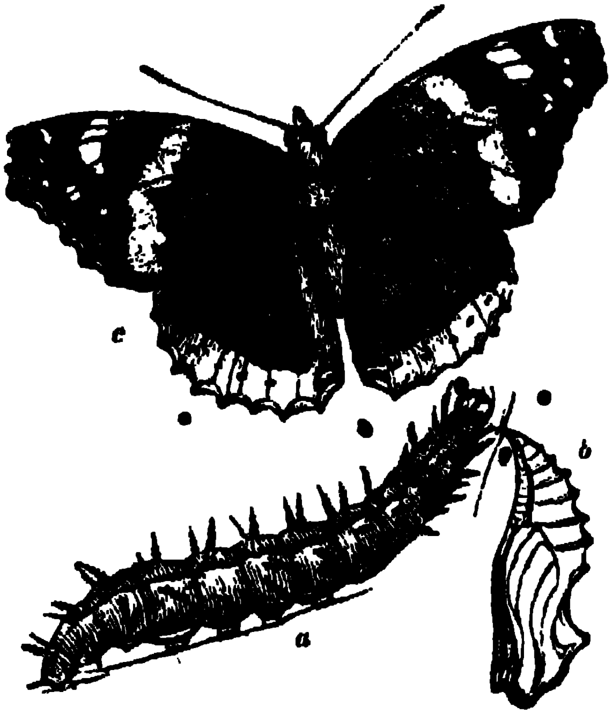

term, however, is objectionable, inasmuch as it is calculated to give an erroneous impression on the subject. The change of the caterpillar or larva (*a*) to the chrysalis or pupa (*b*), and then to the perfect winged insect (*c*), in this species, and nearly all others throughout the whole order, is as complete an external metamorphosis as can possibly be imagined.

(73.) The connection of this order in the circle of the *Ptilota* has been already intimated, and will again be adverted to when we come to speak of the *Hemiptera* and the *Neuroptera.* Several of the hemipterous genera have their wings covered with a farinaceous powder, and dilated quite as much as many of the moths. Mr. MacLeay instances the African *Flata limbata*, as another proof of this affinity; since it is not only destitute of ocelli, but has the antennæ remarkably developed. The immediate means of transition, the same author continues, "is probably exemplified in the genus *Aleyrodes*," whose metamorphosis is described by Réaumer as perfectly resembling that of the *Lepidoptera*. On the other hand, the connection of this order to the *Neuroptera* is effected by the Linnæan genus *Phryganea*; and this so perfectly, that the latter may even be called aquatic moths.

(74.) The different arrangements that have been proposed for this vast assemblage, can only be slightly noticed; for, were we to enter into such details, a moderate volume would scarce contain them. The three great divisions of butterfly, hawk moth, and moth, are so obvious, that Linnæus formed them into as many genera. The distinction was natural, but the denomination artificial; not because they respectively comprised many thousands of species, but because the rank of each group is totally different from those which he denominated genera in the other orders. Fabricius long had the general credit of having first broken up these groups, and thereby made the first step towards a better definition of their contents. But this merit belongs to a countryman of our own. It was in the year 1767, that Moses Harris published his small "Essay preceding a Supplement to the Aurelian,"[*] wherein he not only gives most accurate magnified figures of all the leading types of the British butterflies, but actually divides them into genera. Few copies of this remarkable work, in all probability, were printed; and being given to the world at a time when to doubt the authority of Linnæus was considered scientific treason, the Essay seems to have attracted little or no attention. Harris founded his genera on the neuration of the wings, to which he paid the most minute attention; and his figures of those organs are beautifully accurate. In the year 1776, was published the famous "Vienna Catalogue," as it is generally termed, "the joint production of Messrs. Denis and Schieffermüller, two distinguished officers of high rank at the court of Vienna, who, from their charge in the Imperial Academy, are known in Germany by the name of Theresianer." * These original observers of nature, by the great attention they bestowed upon the metamorphoses of their groups, opened a new field of investigation. Without in the least detracting from the merits of Ochsenheimer, Illiger, Schrank, and Fabricius, it is very clear that all their groups are found in the "Vienna Catalogue;" and that these again, so far as regards the British butterflies, had previously been pointed out by Harris The arrangement of the "Vienna Catalogue" is entirely founded upon the variation of the larva or caterpillar; whereas that of Harris is entirely from the wings of the perfect insect: yet it is an extraordinary fact, that these systems, although founded upon two such different principles, are substantially the same. The groups of the "Vienna Catalogue," in fact, perfectly agree with those of Harris; and this latter author has the particular merit of having first pointed out, in the year 1767, the genus *Leucophasia*, which it was left for Mr. Stephens to revise in the year 1830. The only two attempts that have been made to arrange the *Lepidoptera* according to the natural system, has been one published some years ago †, and the more elaborate exposition in Dr. Horsfield's valuable publication on the insects of Java. The first of these is scarcely worth repeating, and our space is too limited to admit of those details necessary to explain the latter.

(75.) All lepidopterous insects arrange themselves under three primary divisions, which are perceptible to the most inexperienced observer. Mr. Kirby pointedly insists upon this. "The obvious primary sections of the *Lepidoptera*," argues this eminent entomologist, "which have been evident to almost every one, are those three which correspond with Linné's genera *Papilio*, *Sphinx*, and *Phalæna*." The first of these is characterised by having the antennæ terminating in a mass of club (*fig.* 2. *a*), and by flying, with few exceptions, during the day. The second comprise the hawk moths, generally so termed (*Sphingides*), where the antennæ are thickest in the middle (*b*), and gradually narrowed towards each extremity. These insects derive their familiar name from the rapidity of their flight, and from the distant resemblance which may be traced in the profile of their heads to that of a hawk; in general, they fly only during morning and evening. The third, which is by far the largest division, comprehends the moths (*Phalænides*): these fly only in the dusk of evening, or during the night; and their antennæ graduate from the base to a fine point (*c*). These, as Linnæus long ago perceived, are the primary divisions, corresponding to our primary circles of the whole order. But as one of these, or the aberrant, is always resolvable into three others, we find that the nocturnal moths arrange themselves into three great groups, composed of the *Bombycides*, or silk moths; the *Geometrides*, or loopers; and the *Noctuides*, or night moths. Thus we have three aberrant and two typical groups or tribes, corresponding to the quinary divisions of all the other orders.

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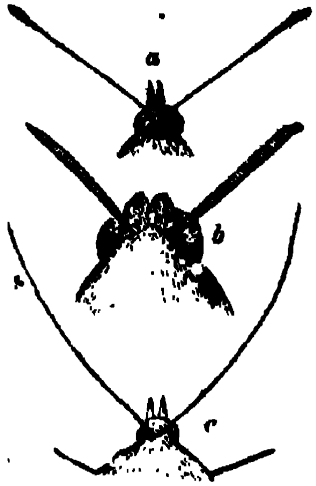
* Horsf. Java Ins. p. 12.

† Taylor's Philosophical Magazine for March, 1827.



(76.) Commencing with the Papilionides, or first tribe, we shall merely observe, that they comprehend all the diurnal butterflies with clavate antennæ, or such as were included by Linnæus under his genus *Papilio*. These we arrange under five distinct families, which, under the following names, we shall briefly notice; namely, 1. the *Papilionidæ*; 2. the *Nymphalidæ*; 3. the *Satyridæ*; 4. the *Erycinidæ*; and, 5. the *Hesperidæ*. The first have six perfect feet, and iuliform larvæ; the second have the anterior feet abortive, and the larvæ are scolopendriform: these two being typical; while the three following are aberrant.

(77.) The arrangement of the *Papilionidæ* into their minor families or divisions has not yet been attempted —

at least, with any reference to their complete circular affinities. We shall not, therefore, at present, offer any other opinion as to their true affinities, than that which we formerly intimated; namely, that the old genera *Papilio*, *Pieris*, *Colias*, and *Dorites* followed each other in a natural order: but analysis has brought to light another group, which we were the first to characterise, under the name of *Licinia* (*Licinia Amphione*, *fig.* 3.): it represents the *Heliconinæ*, and is unquestionably connected to *Colias*. Latreille has mistaken the type of this genus for a *Heliconia*, in which he has been followed by Dr. Horsfield, who cites the larva, of which the only representation is that in Stoll. The general sketch of these groups, which will now follow, is sufficient for our present purpose: they are composed of—1. the *Papilioninæ*, or true butterflies; 2. the *Pierinæ*, or whites; 3. the *Colianæ*, or yellows; 4. the *Lycæninæ*, or large underwings; and, 5. the *Parnassinæ*, or Apollo butterflies.

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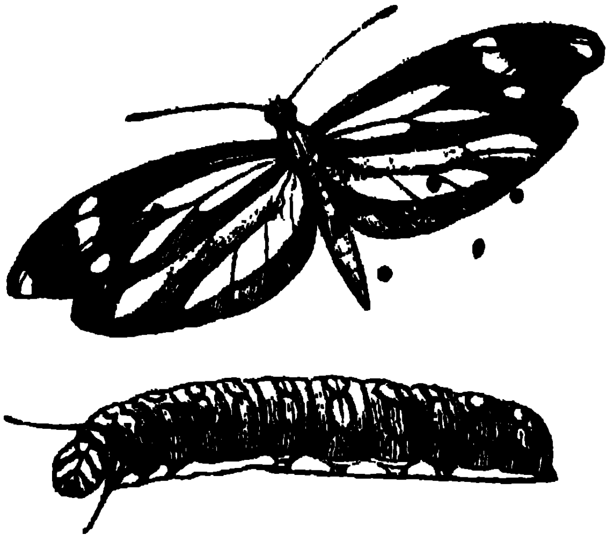

(78.) The *Papilioninæ* are generally termed swallowtails, from the lower wings being dilated into two spatulate lengthened lobes; but this form is by no means general, since near one third of the species have the lower wings rounded. They comprise some of the largest lepidopterous insects, and are at once known by the extreme shortness of their palpi; these parts, in fact, are so small, that they appear, even in the perfect insect, to have been broken off: the antennæ are long, the club very slender, cylindrical, and slightly curved; and the anterior thighs armed with a short acute process in the middle. The sides of the lower wings are cut out, to give a free passage to the body; and all the feet are strong and lengthened. Their colours are not brilliant, but rich and imposing: black or brown is the general ground colour; this being varied with spotted bands of yellow, red, or sometimes green: in some, the wings are striped with black upon a yellow ground. Their flight is not very rapid or strong, and much resembles that of the garden whites. Their geographic distribution is very wide; for although but two species occur in Europe, both of which have been found in England, those of America and India are numerous, while others of much beauty occur in the remote regions of Australia. The group, however, is most abundant between the tropics; yet, like all others strictly typical, it is, in its general range, almost universal.

(79.) The *Pierinæ*, or garden white butterflies, immediately succeed. They comprise several distinct genera. In these butterflies, the club of the antennæ is always suddenly enlarged at the top, and much compressed; while the palpi are clothed with long straggling hairs, and the last joint obviously projects beyond the head. All this will be apparent, on examining one of the common white species found in our gardens. The legs are perfect: the caterpillars are nearly smooth, — merely provided with short downy hairs, thinly scattered over the body: the retractile horns, so general in the last group, are entirely wanting. The ground colour of the perfect insect is generally white; but in that group which passes into the *Papilioninæ*, there is nearly an equal proportion of black; in others (*Euterpe* Sw.), a similar variation takes place; in all, however, the angles or corners of the wings are much rounded, and they offer no example of tails on the inferior wings: hence ensues a weaker flight, while their size is moderate: the under wings have no groove for the body. Their geographic distribution is similar to that of the last family, except that the genera of the Old World are in most cases different from those of the New, and there are as many species in temperate as in tropical latitudes.

(80.) The *Colianæ,* or yellows, exhibit a uniformity of colour seldom met with so decidedly prevalent in all the species. They are of a rich straw colour or bright yellow, entirely destitute of bands or spots; but the under surface is variegated with minute dots, and generally marked by one or two small central silver spots. From the great similarity which prevails, the species are not readily distinguished. The form of the perfect insect, however, is very peculiar: its structure is thick and robust; the wings triangular, with the angles either very slightly rounded or decidedly acute: no other butterflies in this family possess these characters, which all indicate that boldness and vigour of flight belonging to the group. The antennæ also are peculiar; they are very gradually thickened towards the tip, where they end abruptly and without any compression: the anterior feet, although provided with claws, are much shorter than usual; and the lower wings form an imperfect groove for the body. Several species belonging to the genera *Gonepteryx* and *Eurymus* occur throughout Europe, and some of these inhabit Britain; but the typical form is chiefly confined to the tropical latitudes of both hemispheres, where they are found in prodigious numbers: they are, in fact, migratory insects, and represent the swallows in their own tribe.

(81.) Of the *Lycæninæ* we can say but little, since we know not the exact extent of the group: they are, however, immediately distinguished by their large under wings, which are as long, and always much broader, than the upper: the sexes differ so materially, that closet naturalists have not only described them as separate species, but have imagined they belonged to different genera. In structure and appearance they resemble the *Heliconidæ;* but their anterior feet are perfect, while their long wings and very slender shape equally separate them from the *Pierinæ*. The club of the antennæ is long, not abrupt, and greatly compressed; while the head exhibits the peculiar appearance of being porrect, or placed upon a long neck. The larva of one species (*L. Amphione*) is furnished with two solid spines near the head, as in the *Erycinidæ;* but we know nothing of its habits. We first became acquainted with this remarkable group of insects in South America; where, during the autumn of 1816, we captured eight or ten species.* The general appearance of the genus *Leucophasia* induces us to place it at the confines of this group.

(82.) Under the *Parnassinæ* we place the genera *Parnassius* and *Thais* of Latreille, — two remarkable and apparently isolated groups, peculiar to the continent of Europe. *Parnassius*, in its larva state, is provided with the forked retractile horns of the genuine *Papilios;* and its chrysalis appears to be hid within a leaf. In *Thais*, which evidently borders upon the next division, the caterpillar is armed with a row of fleshy spines, and the chrysalis is obtuse at its anterior part.

(83.) The family of the NYMPHALIDÆ, or brush-footed butterflies, next succeed. These are eminently distinguished from the last, both in their larva, their pupa, and their perfect state. In the first, the caterpillar is more or less covered with sharp spines; which gives it, as has been well observed, a terrific or threatening aspect. These spines are often surmounted or accompanied by hairs possessing such a stinging or irritating quality, as to cause the most intolerable pain to those who handle them. This we have unluckily experienced in Tropical America; but no such quality belongs to the British species. The pupa is for the most part angulated, but it is sometimes smooth; in either case, however, it is adorned with rich metallic colours, sometimes disposed in the shape of spots, at others covering the entire chrysalis, which thus seems cut out of a solid piece of metal. Unlike that of the true butterflies, the pupa is always suspended with its head downwards, and is entirely destitute of a transverse thread: some few, representing the silk moths (*Bombycidæ*), live and undergo their metamorphosis within a leaf; these exceptions, however, are very rare. The perfect insect presents us with many peculiar characters. Its whole structure is more robust and vigorous, resembling, in this respect, the *Colianæ*; the anterior feet are short, almost always imperfect, and generally covered by long hairs; whence their popular name of Brush-feet. No general definition will serve to characterise the shape of the wings, as these, no less than the palpi and antennæ, vary in each of the lesser families; but, in general, the under pair are so dilated, as to form a groove for the reception of the body. As illustrations of the more typical

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* The genus was defined and published in *Zool. Illustrations*, vol. i. pl. 15.

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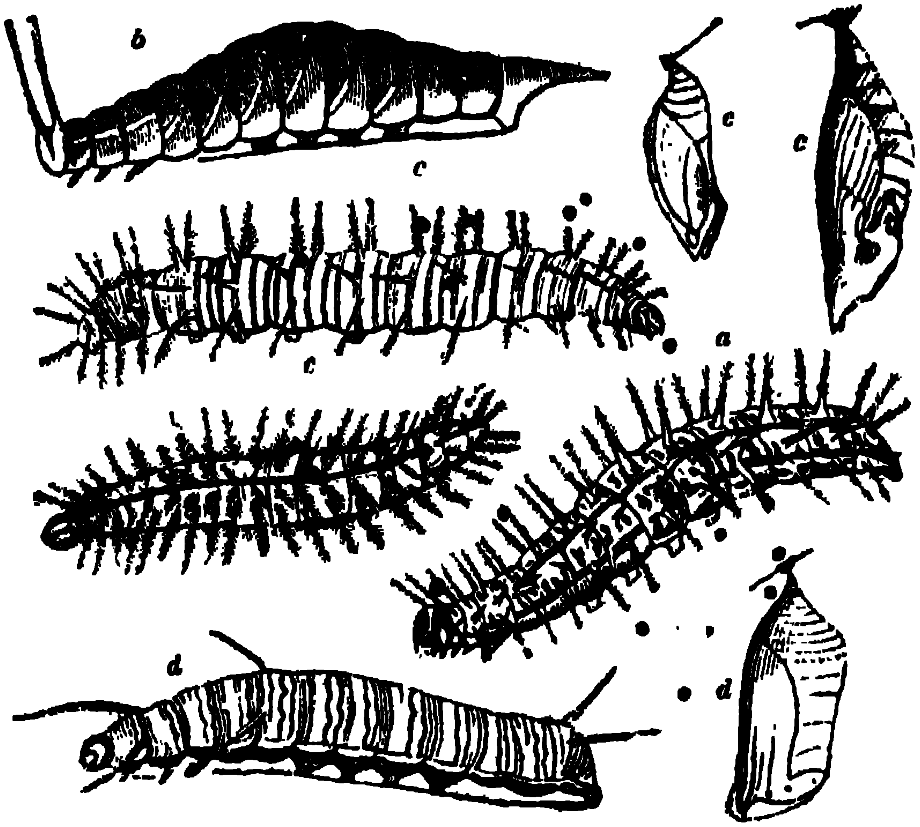

forms of the larva and pupa in this *family*, we may cite that of the peacock butterfly (*a*), which agrees with the general structure above described; but those of the purple emperor (*b*) are seen to be totally different; although the two species, in their perfect state, obviously belong to the same division. In the genus *Acrea*, again, the larva (*c*) resembles that of the peacock, while the perfect insects are totally dissimilar. In the American genus *Euplœa* (*d*), which we place, without doubt, in this family, the caterpillar is furnished with two pair of fleshy processes, — one towards the head, and another near the tail; sometimes the back is furnished with another pair: these processes obviously represent the tufts of hair upon the clear-winged *Zyganidæ* of Brazil, and indicate a very close affinity with them. The pupa, which is smooth, is suspended downwards, and clearly belongs to this division.[*]

(84.) The NYMPHALIDÆ, as a whole, have been considered the typical or most perfect family of diurnal butterflies. On this subject, we had long ago remarked, "If strength of body, rapidity of flight, or brilliancy of colouring, were sufficient to constitute the typical perfections of the diurnal *Lepidoptera*, the award of superiority would undoubtedly be conferred upon this group, did they not show a decided inferiority to the last family, in their less perfect construction. The anterior legs are destitute of claws, and are so short, as to appear at first sight perfectly useless."[†] Now, this peculiar structure of the feet, although, no doubt, admirably adapted to some unknown habits of the insects, is nevertheless, in one sense, an imperfection, when compared with those of the true *Papilionidæ*. We see no reason, therefore, to change the above opinion.

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[*] Dr. Horsfield's illustration of his system, from placing full confidence in the nomenclature of M. Latreille, is unfortunately defective. The larva he has figured at pl. 3. fig. 18. of his beautiful work, taken from Stoll, as an example of *Heliconia*, is that of an *Erycina*. Again, fig. 20. on the same plate, copied from the same work, is not a *Heliconia*, but is that of *Acrea Thalia*,— an insect we have seen by thousands in Brazil; while that at fig. 19. called by Lutreille a *Heliconia*, is that of our *Licinia Amphione* already given in this chapter. (*Zool. Ill.* ii. pl. 91.) The truth is, that we are perfectly unacquainted with the larva of a single species of *Heliconia*. It is entirely an American group, and altogether tropical. We have frequently met with the chrysalis (*e*), but never with the larva.

[†] Phil. Mag. March, 1827.

(85.) The family of Satyridæ, or Argus butterflies, was originally comprised by us in the last division; but more matured reflection, and the analogies they bear to other groups of higher value, induce us to consider them as entitled to a distinct station. They have many peculiarities in their habits, independent of all such as have been pointed out in their metamorphosis. Here we find the largest butterflies in existence; the whole group being analogous to that of the ruminating animals among *Quadrupeds*. Nearly all the typical species are confined to Tropical America. Their colours are distributed on the upper surface, in large masses of shining blue, upon a brown or dark ground. The genus *Amathusa* represents these noble insects in India; but their size is smaller, and they are destitute of brilliant colours. The smaller groups of this family are those only which are distributed over Europe; we have many species in England, known by the familiar name of meadow browns (*Hipparchia* F.). The strong peculiarity which runs through all these groups, is, that the under surface of the wings is invariably ornamented with beautiful ocellate spots: these spots, in the large American species, resemble in form, but not in brilliancy of colour, those on the tail of the peacock; but in the European examples they are smaller, more numerous, and often silvery. The general structure of all these insects, even those of the largest, is weak. The typical groups live only in the dark primeval forests, resting on the trunks of trees during the meridian heat, and show a decided partiality for shade; some, indeed, fly only towards the dusk of the evening. These habits, strikingly contrasting with those of the *Papilionidæ* and the *Nymphalidæ*, show that we have reached an aberrant group of these diurnal *Lepidoptera*; and illustrates that general habit and structure must have more weight than partial considerations, drawn either from the larva, the pupa, or the perfect insect. The natural divisions of this group have never been investigated, and we shall not attempt their definitions. The general structure of the caterpillar in this family is termed by Mr. MacLeay, *Thysanuriform*, or, in other words, bearing a close analogy to the *Lepisma*, and similar apterous insects of the same division. It may be described, typically, as much lengthened, narrow at the end, having two long setæ, or caudal appendages resembling tails; the head being armed with spines, or greatly widened in its form, like a shield: in the less typical groups, the end of the body terminates in two points, and the head is frequently divided in a similar way. The ringlet (*Hipparchia Hyperanthus*), in the larva and all its other stages, is a native and familiar example of the Argus butterflies. The pupa is more or less smooth; and is suspended with the head downwards, similar to the last family. The anterior part is sometimes much pointed; but in the European examples it is generally obtuse. Green is the prevalent colour; but no instances are known of these pupæ being ornamented with metallic colours.

(86.) The SATYRIDÆ, in their perfect or imago state, differ very little in general structure from the *Nymphalidæ*. The anterior feet have the same shortness and brush-formed appearance; the palpi are equally perfect; but the antennæ are more slender. All these circumstances confirm the justness of our observations, that if any one set of characters are made the key-stone of a system, that system is sure to end in being thoroughly artificial.

(87.) We retain the name of ERYCINIDÆ to the next group, because there are many reasons for supposing the genus *Erycina* of Fabricius constitutes the type, rather than that of *Lycæna* or *Polyommatus*, as supposed by some writers.* As the *Satyridæ* contain the largest butterflies, so do the *Erycinidæ* comprehend the smallest. Their forms, however, are singularly diversified; and show how impossible it is to frame a comprehensive character for an extensive group, which is nevertheless strictly natural. The three most prominent groups contained in this family, seem to be represented by the genera *Erycina, Polyommatus*, and *Thecla*. All these, however dissimilar in their perfect stage of existence, preserve a strong resemblance in their larva state. The colours and the habits of these butterflies are particularly varied. The *Erycininæ* are chiefly found in Tropical America: their form is delicate, and they rest with all the wings expanded. Representations of all the groups among the diurnal *Lepidoptera* are found in this small-sized but singularly beautiful sub-family, of which no true example occurs in Europe. That of *Polyommatus*, on the contrary, containing the blue Argus butterflies, is nearly unknown in South America, while it abounds in temperate regions: they are denominated, by our collectors, *Blues;* a rich shining blue being the prevalent colour of the upper surface of their wings, while the under is thickly sprinkled with small ocellated spots. The *Theclinæ* are likewise remarkable for the brilliant azure of their upper surface, but the under is generally marked with slender delicate lines crossing both wings; hence their familiar name of hair-streaks. The genus *Lycæna*, or coppers, on the contrary, are known by their rich fire or copper colour. The former are found in Europe; but by far the largest proportion occur in Tropical America and India. Brazil alone furnished us with more than one hundred species of *Thecla*. The copper butterflies are restricted to the Old World. Both groups, however, bear a strong resemblance to each other in all points of general structure and habit. The caterpillars of this family are of very peculiar make, and stamp the group with every appearance of being a perfectly natural one. By some it is denominated *vermiform;* but as the term onisciform, in this instance, is much more expressive, we adopted the latter upon a former occasion, as we shall now do upon this. The larva is short, broad, flattened, and usually naked: the head is very small, and its general aspect immediately reminds us of an *Oniscus*, or wood louse. In general it is naked (*fig.* 5. *c*); but in some of the Oriental species (*Thecla Jurbus* Hors.) it is hairy, and in others (*T. longinus* Hors. fig. 5.) the surface is much wrinkled. In *Erycina*, the hairs sometimes assume the appearance of tufts; and in the only species

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* See the subgenera of *Polyommatus*, illustrated and defined in *Zool. Ill.* 2d series.

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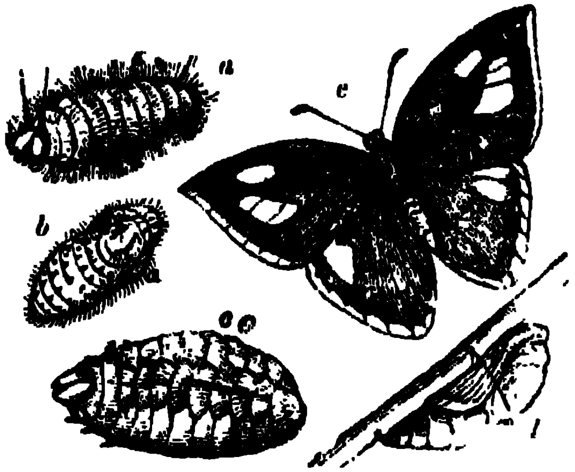

(*e*) of which the larva has been figured, there are two horns near the head (*a*). Much, however, remains to be discovered respecting the transformations of this diversified group.

(88.) The *pupa* differs essentially from that form so generally prevalent in the last family: it is short, thick, and obtuse, attached by the tail, and, in all the European and American groups, braced by a transverse thread (*fig.* 5. *d*). It seems, however, from the figures in the Javanese Catalogue (pl. 4. figs. 1. 2, 4, 5.), that several of the Oriental species are merely suspended with the head downwards, without any transverse brace. Is not this an error of the engraver?

(89.) The separation of the *Erycinidæ* from this family, merely because the larva of the only species whose transformation is known, is furnished with two horns like some of the thysanuriform caterpillars, appears to us highly objectionable, because it is in no degree sanctioned by the structure of the perfect insect. It is almost impossible to bring into contact two more different forms than an *Erycina* and a *Hesperia*, whether we look to them in their larva or their perfect state; and for this, and other reasons, we adhere to the arrangement we formerly proposed.

(90.) The HESPERIDÆ constitute the last family of diurnal *Lepidoptera*. These insects have neither size nor brilliancy to recommend them; while their long, abruptly hooked antennæ give them such an isolated character, that the family can never be mistaken. Nor are their distinguishing characters confined to outward structure. Their flight is even more rapid than that of the *Nymphalidæ*, and, in the more typical species, is performed with such celerity that the eye can scarcely follow the insect. They may, indeed, be compared to the fissirostral or swallow [illegible] among birds, which, in fact, they truly represent; while their palpable affinity to the hawk moths (*Sphingides*), has induced almost every writer to place them as the connecting link between the diurnal and crepuscular *Lepidoptera*. Tropical America is the great metropolis of this family, where the species are so numerous that we found near 300 in Brazil alone: many occur both in India and in Australia; a few in Southern Africa; but we have as yet seen none from the Pacific Islands. In Europe and Britain there are but few, and these are but thinly scattered. Much misconception and many errors exist re- ding the habits of these insects, such as the mode of rying their wings, &c. Some of these we have already rectified.* There are several important divisions in this family, but our present rapid survey will not admit of their particular enumeration.

(91.) The larvæ of the *Hesperidæ* (*fig.* 6. *a, d*) are so strikingly distinguished from those of the *Polyommatidæ*, and the only one known of the *Erycinidæ*, that it is really surprising how entomologists still continue to arrange them in the same group. The larva, in general shape, closely resembles that of the common cabbage butterfly, but with these differences; — the head is very large; and, from the slenderness of the anterior joints, it seems, as Dr. Horsfield remarks, as if

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* Zool. Ill., 2d series.

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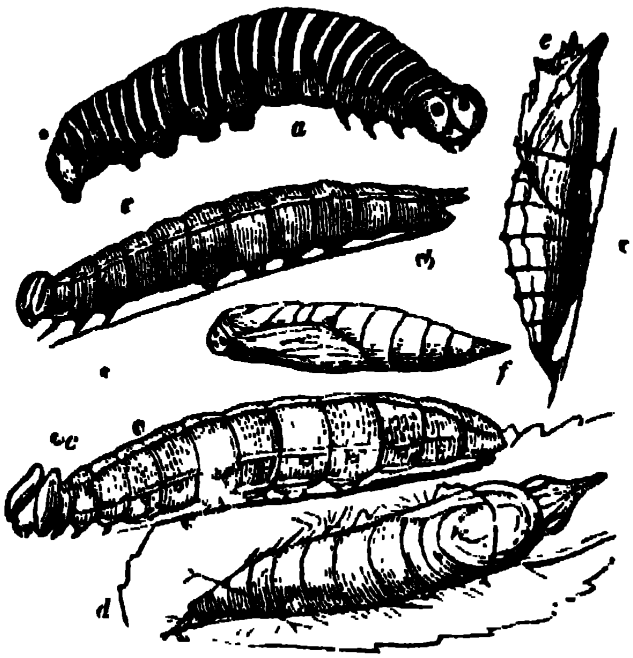


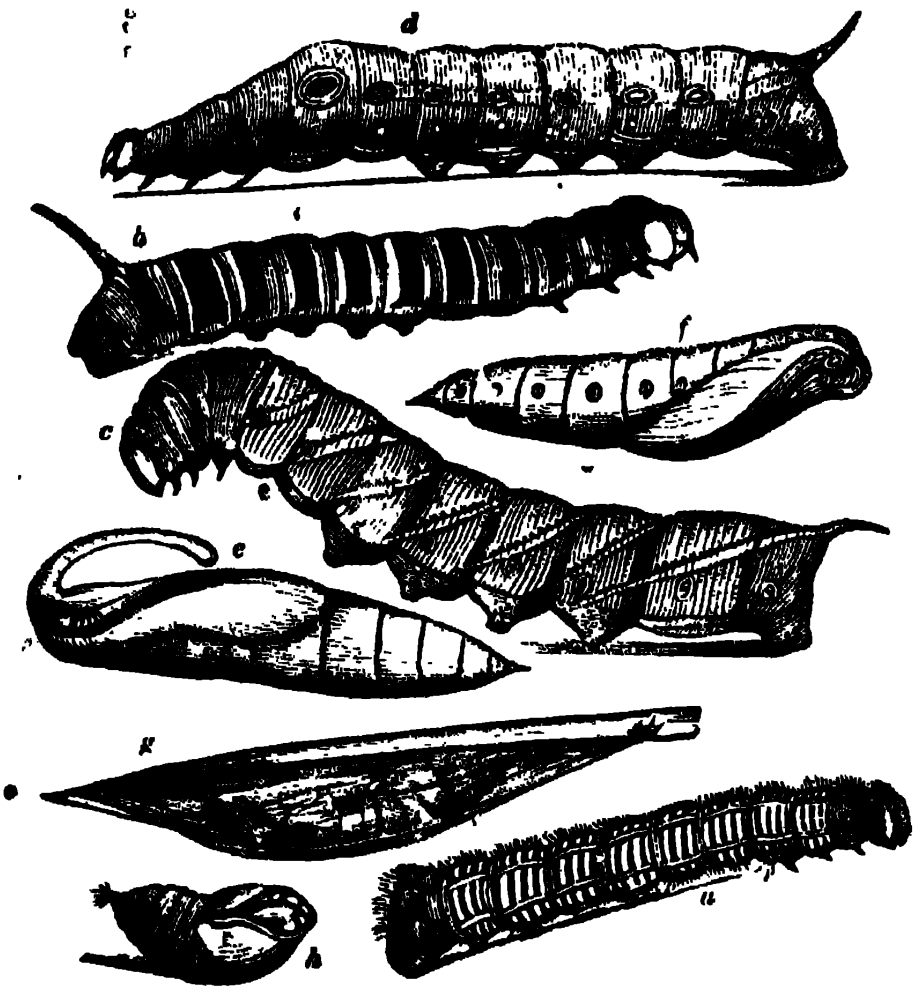
pedunculated: the posterior part is always obtuse, and the surface of the body smooth: it is, moreover, always concealed within a leaf, which it converts into a cylindrical tube; herein the caterpillar resides, and performs its chrysalis transformation. A similar mode of life is observed in the family of *Tortrices*, comprehending those little moths so destructive to our fruit trees in spring, and which disfigure the leaves of the rose at the same period. These, in fact, are the representatives of the *Hesperidæ* in their own tribe; although, from ignorance of the principle of variation, an erroneous idea has been entertained that the circle of the *Lepidoptera* is closed by the union of the *Hesperidæ* with the *Phalænidæ* or moths.

(92.) The *pupa* retains many of those characters seen in the last family, blended with others which more properly belong to the true butterflies (*Papilionidæ*). It is in general smooth (*f*), but sometimes angulated (*e*): its form is lengthened; and it is attached at one end, and braced by a transverse thread at the other (*d*): this change, as we have already observed, is always effected under the cover and protection of a leaf. The examples here figured, of this group, are taken from Stoll, and indicate three remarkable variations both of the larva and pupa.

(93.) The perfect insects are conspicuous for the great thickness of their head and thorax, no less than for muscular strength: many fly in the same manner as the common humming-bird hawk moth of Europe, and are most active during the morning and evening, resting with their wings erect: others prefer the meridian heat, and repose with all the four wings expanded; Others, again, are never seen to take nourishment, but are found in the forests, sheltered under leaves: there is, in short, such a great diversity of habit in this family, that it cannot be defined in precise terms; but in all, as showing their immediate connection to the hawk moths, the eyes are remarkably large and prominent: this affinity is further manifested by the feet, the palpi, &c.

(94.) The SPHINGIDÆ, or hawk moths, compose the second great division of the *Lepidoptera*. They form a tribe, or a group of equal value (although not of extent) to the *Papiliones*, or butterflies, from which they are distinguished both by the form of their antennæ and by the period of their flight. Such, at least, are their popular distinctions, and by which the two groups may be understood by common observers. The typical peculiarities of this tribe are shown in all stages of their existence. The larva, in the principal groups, is very large, thick, and furnished with an incurved horn at the end of the body (*fig.* 7. *c, d*): in some, which resemble the Hesperian larva(*b*), the head is very large; while in others (*d*) it is proportionally small. The chrysalis is never suspended by the tail, or braced by a thread; and the antennæ, unlike those of the diurnal butterflies, are never terminated by a club. The whole structure of the perfect insects denotes great strength and muscular powers of flight; and the wings, when the insect is at rest, are never raised perpendicularly.

7.



(95.) The natural arrangement of this tribe has never been attempted; nor have the primary groups been yet explained. Dr. Horsfield makes five divisions, according to the variation in the larvæ; but he excludes several aberrant groups, which appear to us to belong strictly to this tribe. We shall, therefore, merely indicate what appear to us as primary divisions, leaving the analysis of the whole for further investigation.

(96.) The Sphingides may be contemplated under three great divisions. The first comprises all those which perform their chrysalis transformation deep in the earth; the second spin themselves up in a thin web (*fig.* 7. *d*), and pass this period of their existence near or upon the surface of the ground; while the pupa of the third is entirely enclosed in a thick web, as in *Agarista* (*fig.* 7. *a, g*), or cocoon, attached to vegetables. All the insects of this latter division fly during the middle of the day; it contains, however, insects so very dissimilar in appearance, that we shall divide them into the three subordinate groups. 1. The *Sphingidæ* Sw., or true hawk moths, which constitute a group equivalent to the *Nymphalidæ;* which they also represent. Of these, the typical genus is the well-known death's head (the *Sphinx atropus* Linn.) concerning which there are so many tales of superstition and of terror. This insect, which we have already said is the type of the whole tribe, has been very properly detached from its allies; but the change has been attended with this disadvantage,—that the family name has been left with the others, which are *not* typical, and a new one proposed for this, which is strictly and naturally so. The larva has an ovate truncated head; and the horn at the end of the body is lengthened, naked, and covered with tubercles: when disturbed, it draws itself up in a threatening attitude (*c*); and its whole appearance is then so formidable, that most persons view it with fear. There are, nevertheless, many deviations from this typical structure. In *Smerinthus* (exemplified by our beautiful Poplar sphinx), the head is pointed above, and almost triangular; while in another group the horn is nearly wanting. The *pupa* is terrestrial; and presents a striking peculiarity in the proboscis being detached, as it were, from the body, and protected by a covering of its own (*e*). The perfect insect is generally marked with transverse bands on each side the body; and the end of the abdomen is neither attenuated to a point, nor tufted with hair, but is thick, and comparatively obtuse.

(97.) The ORTHIDÆ, or spinning hawk moths, are smaller and more beautiful than the last. The number of species, and, consequently, of forms, is also much greater. All these, however, are more or less distinguished by a lengthened, pointed body, terminated by a tuft of hairs: in some, these tufts are very small; while in others, particularly the clear-winged *Sesiæ*, or bee-like family, they are very conspicuous. The *larvæ* present us with more instances of variation than the last; but, so far as we have discovered, the *pupa* (*h*) is always enclosed in some substance, either as a protection or as a defence; and this stage of its life is passed at, or very near, the surface of the ground: the proboscis is hid under the common fold enveloping the body of the pupa; and is not protruded, as in the last division. So little has been effected towards the discrimination of this very natural group, that we shall not attempt a natural disposition of the few genera that have yet been defined.

(98.) The *aberrant division* of the tribe appears to be composed of three families: — 1. The *Agaristidæ*, or Hesperian sphinxes. 2. The *Zyganidæ*, or clear-winged sphinxes: and, 3. the *Castniadæ*, or moth sphinxes. The first, in its typical perfection, is almost confined to India and New Holland. The perfect insect more resembles a *Hesperia* than a *Sphinx*, or rather, seems intermediate between a *Bombyx* and a *Hesperia*. The antennæ are sometimes thickest in the middle, in unison with the general character of the whole tribe; yet the tips are slightly but abruptly hooked, as in the *Hesperidæ*. These curious and apparently anomalous circumstances appear to have much perplexed some writers. Dr. Leach seems inclined to place the *Agaristidæ* with the moths, near to *Noctua Sponsa*,—but he confesses his doubts on the subject; while Donovan brings them in with the *Hesperidæ*. The larva of the only species yet known, very much resembles that of a full-bodied *Sesia* deprived of its horn (*fig.* 7. *a*); while the pupa (*b*) is enclosed in a slight web, "spun on the stem of its food under the leaves *;" and the perfect insect flies by day.

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* Lewin's Ins. of New South Wales, pl. 1.

Of the aberrant forms nothing can here be said, since the group itself has hitherto received but little attention.

(99.) The *Zyganidæ*, or more properly the *Atherocéridæ* (since the former name has long ago been employed in Ichthyology,) is the most extensive and varied family of the whole tribe. Like the last, they are day flying insects, small in size, but richly coloured; with fusiform, but generally pectinated, antennæ, and very small posterior wings: their structure is altogether weak, and their flight slow and feeble. A few examples of one of the minor groups occur both in Europe and Britain, but the major part inhabit the tropical latitudes of America and India. The typical groups are distinguished by their clear and transparent wings; but they are readily known from the brush-tailed *Sesiæ* of Europe, by having no tufts at the end of their abdomen; and this part is also much thicker. The metamorphosis of this family has been admirably illustrated by Stoll, in his supplementary volume to Cramer. The larva is onisciform; but is either covered with tufts of long hairs disposed in bunches or *fasciculi*, or by elevated soft protuberances. The pupa is always enclosed either in a cocoon, or in a fusiform strong web, attached to plants. The resemblance between many of these insects and the Australian family of *Agaristidæ** is so close, that nothing but a close investigation will determine the genera respectively belonging to each. This is, perhaps, the most interesting group in the whole tribe; since we find representations of every order, and of nearly every family, of lepidopterous insects: many put on the appearance of wasps, bees, beetles, moths, butterflies, flies, &c.; and the resemblance is so exact, that even an experienced eye will not at first detect the difference.

(100.) The *Castniadæ*, or moth sphinxes, conclude our sketch of this tribe. This is a very peculiar family, which, from their economy being entirely unknown, has long perplexed entomologists, and some strange locations have recently been assigned to them. We were fortunate in observing many of this family in their native regions, and thus obtained a clue to their natural affinities. The perfect insects fly with great rapidity during the heat of the day, and much in the same manner as the typical *Hesperidæ*, yet we never saw them settle upon flowers; and when they rest, it is generally on the shady stem of a large tree, having the wings invariably deflexed or incumbent, similar to the nocturnal moths (*Noctuides* Sw.). The transformation of one species (*Castnia Licus*) is imperfectly figured on the thirty-sixth plate of Merian: the larva is represented as long, thick, smooth, and much resembles that of a *Pieris*: the pupa, according to this figure, appears suspended from a plant by the posterior extremity.* The perfect insects are the largest of the whole tribe: the wings are broad, powerful, and the farinaceous scales so large, as to be distinguished, in many species, by the naked eye. The head is very small; and the antennæ are intermediate in form between a *Sphinx* and a *Hesperia*. Dr. Horsfield, in his general survey of the *Lepidoptera*, has altogether omitted this group, the characters of which we illustrated several years ago.†

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* Some few American insects, however, enter into this group.

(101.) The third primary division of the order comprises the *Phalænæ* of Linnæus, better known by the name of moths. These insects, with a few exceptions, are completely nocturnal; concealing themselves in the day, and flying abroad during the dusk. Their size, in general, is small; although some few are among the largest *Lepidoptera* yet discovered. They undergo the same three-fold transformation of all lepidopterous insects; and, like them, feed upon the nectar of flowers. Several, however, by a singular provision of Providence, seem to take all the nourishment necessary for their support, in the caterpillar state; since, when they become moths, they never have a proboscis.

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* Merian's figures, however, are not always to be depended upon.
† Zool. Ill., pl. 149.

(102.) As we believe that the three aberrant groups of every circle form one, we shall, with Mr. Kirby, consider the nocturnal moths as one group, resolvable into three subordinate divisions; namely, 1. the *Bombycides*, or spinners; 2. the *Phalænides*, or loopers; 3. the *Noctuides*, or night moths. So little has been done towards the philosophic investigation of these groups, that, while their genera have been multiplied, and are daily multiplying, in the artificial systems of the day, the study of their affinities has been of late years much neglected. We shall, therefore, merely touch upon the general characteristics of these tribes, and leave most of the families for future investigation.

(103.) The BOMBYCIDÆ, or silk-spinning moths, comprise some of the largest *Lepidoptera* in existence. Although not a very extensive tribe, it is one of much interest, as containing those insects most serviceable to man; and the only ones, excepting the bees, which can be said to be cultivated or domesticated. When we recollect the innumerable purposes to which silk, the produce of these wonderful insects, is applied in Europe, and that the greatest portion of the Asiatics absolutely depend upon its fabric for their own clothing, we see that, like the ruminating quadrupeds, Providence has more especially ordained them to furnish comfort and convenience to man. Nor is this power confined to a single species. The silkworm of Europe, although originally imported from Asia, is only one out of several inhabiting the Eastern world; each producing a silk of some peculiar quality, and distinguished either by its fineness, colour, or durability. The most marked distinction, indeed, of the whole group, is their enclosure, during the pupa state, in an egg-shaped case, or cocoon, rendered impervious to wet or other injury by the innumerable folds of silk which the caterpillar spins around it; the whole being attached to trees or plants. In the pupa itself, there is nothing peculiar; it lies within the case, unattached either by the tail or by a transverse thread. The perfect insect is remarkable for the very small size of the head: this part projects so little beyond the thorax, that, in the typical species, it would scarcely be perceived, but for the broad and highly pectinated antennæ, most conspicuous in the male sex: the palpi are very minute, hairy, and lie close to the head; while the wings are broad, large, and ornamented, in all the typical examples, with transparent ocellate spots.

(104.) The natural divisions of the *Bombycides* are completely unknown; but as, for the purpose of reference, and the more easy detection of species, it is essential to make some rude assortment of the genera, we shall place them under the following heads, until a better acquaintance with the whole has been obtained by analysis: — 1. *Hepialidæ*, or ghost moths; 2. *Bombycidæ*, or silk spinners; 3. *Arctiadæ*, or tiger moths; 4. *Lithosiadæ*, or day-moths; 5. *Cryptophasidæ*, or hermit moths.

(105.) These divisions may be thus slightly characterized.—The first are chiefly composed of large, full-bodied insects, with long narrow wings; and feed, during the caterpillar state, within the trunks of trees. The larva is either entirely naked, or thinly covered with scattered hairs. The second, or true silk worms, has been already noticed: the larva is generally covered with stellate tufts of short hairs, very stiff, and sometimes endowed with a poisonous, or, at least, a highly irritating quality. The third comprises all those usually denominated tiger-moths, from the black spots which ornament their red or orange under wings: the larva is covered with long hairs in every part of the body, and merely spins a thin transparent web enclosing the chrysalis. The fourth seems to be typically distinguished by flying during the day. The larva is generally ornamented with tufts of long silky hairs, of which there are two more conspicuous than the others near the tail, two more near the head, and two towards the middle of the body. It is very clear that this family represents the *Zyganidæ*, or clear-winged sphinxes of South America;

but, although we can readily distinguish the typical forms, it is very difficult to determine which are the aberrant. The fifth and last division seems closely allied, both to the *Tortricidæ* in the next family, and to the *Hepialidæ* in this; they are, however, distinguished by an economy so remarkable, that we shall view them, for the present, as a separate group. The larva, in shape, much resembles that of the goat moth; the head is large, and on the body are a few scattered hairs: the chrysalis is not enclosed in any web, but lies within the chamber, or habitation, previously made by the caterpillar in the solid trunk of the tree. The perfect insect differs from all the families we have here noticed, in having the palpi curved up before the eyes, and diverging: the antennæ, also, are very long; and the wings possess a peculiar glossiness. We are indebted to the late J. W. Lewin for a knowledge of these extraordinary moths, hitherto found only in New Holland, and which he has admirably illustrated in his "Prodromus" of Astralian Entomology. It is, perhaps, owing to the rarity of this book, that modern systematists appear but little acquainted with these singular insects.

(106.) The *Phalænidæ*, properly so called, constitute the second division of the nocturnal *Lepidoptera*. Without attempting to define this great and diversified group by characters applicable only to a small portion, we shall merely premise that they are, as a whole, the smallest and the most delicately constructed insects in the whole order. The thorax is small, the body thin, and the antennæ resemble a filiform thread, rather thickest at the base: they are thus distinguished from the thick bodied *Bombycides*, with their pectinated antennæ; and from the strong and full bodied *Noctuides*, by their slender and delicate shape. The popular name of *Loopers* has been given to the first or typical division of these insects, from the movement of the caterpillar when walking, the body being then raised in the middle in the shape of a loop: in this group, also, the larva has only ten feet: the perfect insects constitute the *Geometræ* of the Linnæan school. The *Tortrices*, however, should first be noticed, as they show, in many respects, a close approximation to the last family of the *Bombycides:* they are beautiful little moths, having the habit, in their larva state, of rolling up the leaves on which they feed, and in which habitation they pass the chrysalis state: excepting in size, these caterpillars closely resemble those of the New Holland group above mentioned; and we have no doubt but that analysis will fully establish this singular and unexpected affinity. The third family is composed of the *Tineidæ*, the smallest of the whole order; some are, indeed, so minute, that the collector finds it difficult to insert a fine pin through their thorax: most of the species are ornamented with spots of silver or of gold, so as to exhibit, under a high magnifying glass, some of the most beautiful combinations of colours in nature: the antennæ are often very long, and the wings fringed with delicate hairs: the larvæ are singularly diversified; and this group, which all entomologists agree is a natural one, offers the strongest argument against all systems built exclusively upon the larvæ: some of the caterpillars have eight feet, some fourteen, and some sixteen. The true *Phalænidæ* are the largest insects in the tribe, and in the shape of their wings they very often resemble the diurnal butterflies; the larva has twelve feet; and in every stage of its existence we see an obvious affinity to the succeeding division of night moths (*Noctuides*). Finally, we should notice the *Pyralidæ*, remarkable for their long legs, for their aquatic habits, and for the propensity of many of the species to fly during the day.

(107.) A few remarks on the *Noctuides*, the third and last division of the moths, will conclude our rapid survey of this order. This natural and very numerous tribe may be immediately distinguished from the two former, by their simple setiform antennæ, their short but stout body, their large eyes, and their projecting palpi, usually naked at their tip. The caterpillars are greatly diversified, but the pupa is almost universally terrestrial,—

that is, neither suspending itself in the air, nor enclosed in a cocoon, but buried deep in the ground. The habits of the perfect insects themselves are usually, as their name indicates, nocturnal, although not exclusively so, as many of them flit about in the sunshine, especially towards the time of its setting, and as the shades of evening fall; but this is doubtlessly preludatory to their nocturnal gambols. We consequently find their apparel in the strictest accordance with these peculiarities; and nature here again exhibits its rigid rule of strict economy, for it will not even waste a shade of colour that has not its specific object and purpose. The majority of these insects are either sombre or very plain in their clothing, browns, drabs, and greys, being the predominant tints; yet, although so obscure, these tints are elegantly diversified by spots and markings, which amply compensate for greater and gayer varieties of colour, and thus evince a further corroboration of the favouritism of Nature which is every where so prominently exhibited towards this large and beautiful order of insects. In those, however, which are more diurnal in their habits, we observe occasionally a departure from this sobriety, which has acquired for many of the former the name of quakers. Thus, in the *Plusiæ,* we see the wings studded with drops of gold and silver. In the *Xanthiæ*, the colours are shades of yellow, orange, straw, and lemon; in *Catacola,* the under-wings are of rich crimsons and reds, contrasted with a bar of intense black; in *Bryophila* and *Diphthera,* the superior wings are elegantly variegated with green. There is so much diversity in the structure of the larvæ of this group, that we may almost assume this to be its typical characteristic; and this would point to *Acronycta,* as the most typical genus, from the great differences it exhibits within itself in this preliminary stage of developement: and it is a remarkable fact, that even the most experienced entomologists are sometimes baffled in determining the specific differences of perfect insects in this group, which have their larvæ extremely dissimilar. The position we thus assume for *Acronycta* is probably supported by its colouring, which seems central, in the group of those which are least diversified by varieties of tint, and associating with them we observe *Polia, Hadena, Celæna, Miana, Mamestra, Rhizolitha, Xylina, Orthosia,* and *Agrotis,* if the latter, however, might not dispute position with *Acronycta.* We have just alluded to the difficulty that even skilful entomologists have in determining the differences between closely allied species; but to the young entomologist, this entire group will form an admirable exercise for his sagacity, and the gradual decrease of the difficulties it presents will be a sure test of the progressive developement of that peculiar tact, so essential, especially to the entomologist, yet which is more difficult to acquire than knowledge, although, when once thoroughly possessed, it is invaluable to the naturalist, from the universality of its application. [W. E. S.]

CHAP. III.

THE HEMIPTERA.

(108.) The order HEMIPTERA is the second, or subtypical, division of the *Ptilota.* Its rank in the circle of that class, and its integrity, has been already demonstrated; we therefore think it unnecessary to combat the opinion which some have entertained, that the *Hemiptera* of Linnæus, or rather of Latreille, is not of itself a natural group; still less to discuss the fancy (for we can call it nothing else) of a few modern systematists, that they are composed of two distinct orders! One would almost think that these pseudo-orders were dissimilar. The position we thus assume for *Acronycta* is probably supported by its colouring, which seems central, in the group of those which are least diversified by varieties of tint, and associating with them we observe *Polia, Hadena, Celæna, Miana, Mamestra, Rhizolitha, Xylina, Orthosia,* and *Agrotis,* if the latter, however, might not dispute position with *Acronycta.* We have just alluded to the difficulty that even skilful entomologists have in determining the differences between closely allied species; but to the young entomologist, this entire group will form an admirable exercise for his sagacity, and the gradual decrease of the difficulties it presents will be a sure test of the progressive developement of that peculiar tact, so essential, especially to the entomologist, yet which is more difficult to acquire than knowledge, although, when once thoroughly possessed, it is invaluable to the naturalist, from the universality of its application. [W. E. S.]

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(109.) The characters of the *Hemiptera* are of the most simple and obvious description: they are the only four-winged insects, besides the *Lepidoptera*, that are altogether destitute of mandibles and maxillæ; hence these two great orders are the most perfectly suctorial, and, therefore, the most perfectly typical, of true insects. Adhering to the admirable views of Latreille, we shall define the order nearly in his own words. In place of the mandibulæ and maxillæ of other insects, not suctorial, the mouth is composed of a tubular articulated proboscis, or rostrum, which assumes various shapes, but is always bent, more or less, beneath the head, and generally reposes upon the pectus, or breast, along its upper surface; and reposing in a groove, are three stiff and fine bristles, the base of which is covered by a tongue; these bristles, when united, form a sucker, which often performs the office of a sting or barb, with which the animal pierces other insects, or sucks the nectar of flowers. The mouth, in short, is formed entirely for suction; and it is only in the genus *Thrips*, which unites this order to the *Hymenoptera*, that there is any appearance either of jaws or of palpi. The second character in importance, is that furnished by the wings; but this is much more variable than the last. In the typical tribe, the upper wings are horizontal, slightly coriaceous, and are crossed at their extremities; at which part they are, like the lower wings, membranaceous. In the sub-typical tribe, the upper wings do not fold over each other at their ends, but lie compactly on the sides of the body, as in most of the nocturnal moths, their substance being very little thicker than the under wings; and both are generally transparent, or nearly so. The metamorphosis is imperfect; that is to say, very slightly developed: the *Hemiptera* undergo, it is true, the changes of larva and pupa, previous to becoming perfect insects; but, in these two rudimentary states, they are as active as their parents, from which they are alone to be distinguished by the absence of their wings. The larvæ rapidly increase in size; and, after casting their skin, become pupæ. It is in this latter state only that the rudiments of wings, in the shape of scale-like processes or tubercles, are first perceptible; the developement of these into perfect wings constitutes the adult insects. Thus, although the *Hemiptera* are so intimately connected to the *Lepidoptera*, that there are insects in each which render their division by no means easy, they are yet strikingly inferior to them in point of metamorphosis. On the nature of the connection between these orders, we shall subsequently enlarge, as well as upon that between the *Hemiptera* and *Hymenoptera*. We shall, therefore, at once proceed to notice the primary groups or tribes, and endeavour to trace their analogies in other orders.

(110.) We arrange all hemipterous insects under the five following tribes:—I. The CIMICIDES, or bugs, where the upper wings are more or less horizontal, and fold over each other at their extremities.—II. The CICADES, or cicadas, having the upper wings deflexed, or incumbent on the sides, and of a subtransparent nature throughout: the rostrum is placed on the lowest portion of the head, and is used only to feed on the juices of vegetables: the antennæ are very short, and resemble fine bristles: the females are furnished with an ovipositor, which is used as a saw to effect openings in plants, for the reception of the eggs.—III. The APHIDES, or plant lice, in some respects resembling the last, but immediately distinguished by their long filiform antennæ, their very minute head, the absence of an ovipositor, and by having only two joints to their tarsi.—IV. The COCCIDES, or blight insects, where the tarsal joints are five; the wings, where they exist, are only two, and lie horizontally on the body, one over the other: the females are apterous, and onisciform, and are alone furnished with a rostrum.—V. We place, as the type of the last tribe, the genus ALEYRODES of Latreille; distinguished from all others, by undergoing a complete metamorphosis; and in other respects so much of a lepidopterous insect, that both Linnæus and Réaumur placed it within that order. The whole may be arranged in the following manner:—

Analogies of the HEMIPTERA.

Tribes of the *Hemiptera.*	*Analogies.*	Orders of the *Ptilota.*
	Raptorial; chiefly living upon other insects.	HEMIPTERA.
CICADIDÆ.	Wings with distinct nerves; often covered with a farinaceous substance	LEPIDOPTERA.
APHIDES.	Gregarious, furnished with caudal appendages, and secreting honey.	HYMENOPTERA.
COCCIDES	True wings only two; the most imperfect flyers.	COLEOPTERA
ALEYRODIDÆ.		NEUROPTERA.

(111.) It is a remarkable fact, that all the orders of the *Ptilota* exhibit one primary division which is rapacious, that is, preying upon other insects, as the lions and tigers among quadrupeds, and the falcons among birds. The universality of this law is manifest in every order above named; and the *Hemiptera*, as a whole, being the raptorial order of the circle of the *Ptilota*, so the *Cimicides* are the pre-eminent types, standing at the head of their own order, and consequently representing it. The *Cicades* have such an acknowledged resemblance to the *Lepidoptera*, that many authors have actually thought they passed into each other, without the intervention of any other group; so that, were it not for the remarkable structure and metamorphosis of *Aleyrodes*, we should be disposed to place some of the aberrant *Cicades* in that rank we now assign to *Aleyrodes*. The whole of the *Lepidoptera*, and the *Cicadides* also, are herbivorous; or, at least, never touch animal substances; for both live on the juices or nectar of plants, in their adult state.* The analogies, therefore, of these two orders are not only placed beyond all doubt, but find their corresponding representatives in vertebrate as well as annulose animals. The *Aphides*, or plant lice, are the bees of the *Hemiptera*; for these two groups contain the only insects which secrete honey. This resemblance, however, is not a mere analogy, but an affinity. Latreille, without any scruple, places *Thrips* in the same division as *Aphis*, from which, however, it differs so remarkably as to possess jaws; and he alludes to a fact, what every one may verify,—viz. that when these insects (*Thrips*) are irritated, they turn up their body in the manner of the *Staphylini*. The resemblance which the onisciform shape, and often the coriaceous covering, of the *Coccides* bears to *Coleoptera*, exactly accords with every thing we have said on the analogies of the latter group. They have the hardest covering of all insects; just as the armadillos among quadrupeds, and the chelonians, or tortoises, among reptiles. Pursuing the especial analogy apparent in our table, we find, also, that the *Coccides* and the *Coleoptera* are the most imperfect flyers in their own groups: the females of the former are apterous; while the wings of the males are only two, and these fold over each other, horizontally, on the body. The reader will remember what we have said on the wings of the *Coleoptera*, which, in effect, are but two-winged insects; the upper pair, or elytra, being almost useless as organs of flight. With such striking and even beautiful representations of four out of the five orders of the *Ptilota*, as this table substantiates, we may very well leave the last for future investigation. The truth is, that, until the aberrant tribes of the *Hemiptera*, and perhaps even those which are typical, are properly analysed, it will be manifestly impossible to determine what other insects enter into that group where at present we place only *Aleyrodes*. We should not be surprised, however, if some aquatic or sub-aquatic form may eventually be added to it; and this alone would be quite sufficient to establish an analogy to the *Neuroptera*.

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* The raptorial feet of the larvæ of the cicadas may possibly be used to press out the juices of leaves, &c.

(112.) The analogies of the *Hemiptera* to all other groups, whether of vertebrate or annulose animals, may be traced through the foregoing exposition; for, if this is substantially true, it follows, as a matter of course, that the *Hemiptera*, like the *Ptilota*, have their prototypes among all circular series of animals: one only of these will, therefore, be noticed, since every experienced entomologist can now pursue this line of inquiry. This comparison will bring the *Hemiptera* into junction with the *Coleoptera*.

Analogies of the HEMIPTERA *to the* COLEOPTERA.

Families of the *Predatores*.	Tribes of the *Hemiptera*.	*Analogies*.	Tribes of the *Coleoptera*.
Cicindelidæ.	CIMICIDES.	Rapacious; feeding upon other insects.	PREDATORES.
Carabidæ.	CICADIDES.	Saprophagous; feeding upon vegetable fluids.	LAMELLICORNES.
Dyticidæ.	ALEYRODES.	?	MALACODERMES.
Silphidæ.	COCCIDES.	Body short, oval; antennæ moniliform; frequently apterous.	MONILICORNES.
Staphylinidæ.	APHIDES.	Antennæ very long and slender.	CAPRICORN.

We have merely added the first column, or that of *Predatores*, to show the analogy between *Thrips* and the *Staphylinidæ*, as noticed by Latreille. Indeed, it is so deceptive, that when these minute insects are seen running upon paper (for they frequently fly into our study at the very time we are writing), they look just like their minute prototypes so common in summer. The analogy between the cicadas and the lammellicorn beetles is very strong, for the types of each feed upon vegetable juices; but this, of course, is not applicable to the *Carabidæ*, whose only relation to the *Cicadides* consists in both being in the subtypical groups of their own circles. The tortoise beetles (*Cassidæ*) are the types of the *Monilicornes;* and who that looks at a *Coccus* can doubt of one being intended, by Nature, to represent the other? The *Aphides,* like the capricorn beetles, are remarkable for the great length of their antennæ; a remote resemblance, indeed, but still a resemblance altogether in unison with the natural series in which these groups are here placed.

(113.) The typical tribe of the order before us is that to which we give the name of CIMICIDES, as corresponding, with a little variation, to the genus *Cimex* of Linnæus. It comprises a very large assemblage of insects, at once known by the upper wings being crossed at their tips, one over the other, where they are thin and membranaceous the rest of the wing being of a thicker and more opake substance: the rostrum or mouth arises in front of the head; and the thorax (according to the modern theory) is formed by the first segment of the trunk: the scutellum is almost always conspicuous, and is sometimes so enlarged as to cover the whole body, and give the insect an appearance, at first sight, of being coleopterous; the antennæ, in the typical groups, are linear, nearly of equal thickness, and generally much longer than the head; the joints being very few, and distinctly seen, so as to produce angles: the tarsi are of three joints, in such genera as are cursorial, while those which are aquatic have but one or two joints. Thus characterised, as a whole, we are disposed to arrange the great majority of these insects into the following primary groups:—1. The *Pentatomidæ,* or wood bugs, having the rostrum long, slender, concealed, and reposing upon the breast: the body is short, oval, and generally half as broad as it is long: they live for the most part upon vegetable juices; but appear to prey upon such smaller insects as come in their way, probably at certain seasons.—2. The *Reduviidæ,* or rapacious bugs, where the rostrum is very short, much resembling the thick but curved and sharp bill of a bird; it is very acute, and capable of inflicting severe wounds: the last joint of the antennæ is often very slender, and even setaceous; the body more lengthened and narrow than in the former family; the head remarkably small, the neck contracted and exserted, and the eyes very prominent. The whole of this family are raptorial, feeding entirely upon other insects which they capture and suck: some are terrestrial, while others are sub-aquatic, and appear to lead to the next,—3. The *Nepidæ*, or water scorpions: these comprehend the largest of all the tribe, and are immediately known by the extreme shortness of the antennæ, which are inserted and nearly concealed under the eyes. Like the last family, they are carnivorous, and seize their prey by their raptorial fore-feet. The tarsi have never more than two joints; and the hind legs, in general, are ciliated for the purpose of swimming. The two remaining families, in the absence of the requisite analysis, we shall not venture to characterise. One may probably be represented by the common bed bug, which, from its general structure, and from being apterous in all its stages, seems to form a family type, particularly from its analogy to the *Coccidæ* in the next tribe. But on the 5th, which, from theory, we suppose would represent the *Centronotidæ*, we are confessedly ignorant; nor can this deficiency be supplied until the natural station of such genera as *Velia*, *Gerris*, and some others has been worked out. Under these circumstances, the slight notice of the principal genera which seem to belong to the three primary groups first mentioned, is all that can be at present attempted; after which we shall enter more at large into the remaining tribes of the order.

(114.) The *Pentatomidæ*, as we apply the term in preference to creating a new one, must not be considered so exclusively and restrictively as its usual application would imply. Its definition, given above, shows that it comprises many insects not before included in it. It consists of three large families of the more recent systematists,—namely, the *Scutati*, *Corei*, and *Lygæi*. It is thus seen to embrace many interesting forms, which are usually very beautiful insects, gaily decorated with a variety of colours and markings, and occasionally enlivened with metallic brilliancy. The *Scutati* are at once characterised by their name; for in this family, which is of considerable extent, we observe, in the more typical division of it, the scutellum so largely developed as frequently to cover the abdomen. In these insects we detect also many which greatly resemble the *Coleoptera:* some, in the elongation of their form, and metallic colour, are remarkably like *Buprestis*, instanced in *Calidea*, *Peltophora*, and their allies. *Sphærocoris*, again, is a completely mimicking representation of the *Coccinellidæ*, both in form and markings; and in *Scaptocoris*, in which the scutellum is less developed, we have the representation of a lamellicorn beetle, wanting its posterior tarsi. A convincing proof that these resemblances are exceedingly strong, is shown by the circumstance that describers have frequently given them specific names in allusion to the particular analogy the insect offered. We have Linnæus, even, leading the way with his *Cimex Scarabæoïdes*. These resemblances, also, are not confined to this group only, but they likewise extend into the two following. The genus *Podops*, of which we possess a species in this country, is remarkable for its pedunculated eyes. The reputed British *Coptosoma globus* presents a unique instance in the *Hemiptera*, of the folding of the hemelytra in repose; for these organs, being considerably longer than the body, could not otherwise be brought under the protection of the large scutellum. *Solenosthedium* Spin., and *Coleotichus* White, are conspicuous for having a deep channel, for the reception of the rostrum, in the pectus, the sides of which have singularly elevated ridges. The genera which have an enlarged scutellum, from the protection this affords to the hemelytra, or superior wings, of course dispense with the coriaceous texture observable in those which are not so formed; for otherwise it is only where these organs lap over each other, that the membranaceous substance prevails; but in the *Reduvii* we frequently observe a nearly entirely membranaceous texture of the superior wings. In this family, the latter structure occurs in all the true *Pentatomæ.* Very little is actually known of the habits of these insects; it is presumable, however, that the majority feed upon other insects; and a friend of ours has observed *Pentatoma bidens* preying upon *Vanessa Io,* which implies a degree of skill in the capture of its prey we were scarcely prepared to expect in any of this group. If there be no mistake in the account given us by Westermann, of the destruction caused by *Thyreocoris silphoïdes* in rice fields, in Hindostan, the family evidently feeds upon a variety of substances; although may it not be that these insects are found in profusion amongst those crops, themselves seeking the true destroyer? We can here give but a very general idea of the group, which is so large, that the space we can allot to it would scarcely suffice to record their generic names. In the next family, the *Corei,* which, from their great variety, will scarcely yield to a collective character, we observe insects in which the sides of the abdomen are frequently considerably and angularly dilated; the wings, when closed, having their sides always parallel, and leaving those lateral portions of the abdomen uncovered; but this dilatation is not always found in them. It is observed chiefly in *Coreus* itself, and remarkably so in *Phyllomorphus paradoxus* and *hystrix,* in which these appendages are dilated into thin lobated plates, and extend also from the sides of the prothorax. In *Anisocelis* we observe the posterior tibiæ laterally dilated into a thin foliaceous appendage, as are the antennæ in *Pachylis,* which besides contains the largest species of the family; one, the *P. gigas* Kirby, being more than an inch and a half long. In *Physomerus, Merocoris,* and *Meropachys,* we find very largely swollen posterior femora. Some of these insects still present a moderately large scutellum, which, although less than in the preceding family, is always larger than in the next; and in *Menenotus,* which seems to connect the *Corei* with the *Pentatomæ,* we find the thorax produced laterally forwards, giving it the appearance of a crescent, whence one species has been named *lunatus*. The prettiest species we possess, in this country, of the family, is the *Corizus Hyoscyami*, which is not uncommon; it is of a brilliant vermilion, spotted with black. We may also notice here the very slender and elongated form of *Berytus* Fab. (*Neides* Latr.), of which the *B. Tipularius* is frequently found in our fields, and the delicate antennæ of which are acutely angulated at the apex of the basal joint. By means of this form, the transition is easily made to the third family, the *Lygæi*, which consists of elongated insects. As in the preceding families (with but two or three exceptions, viz. in *Pyrrhocoris*, *Largus*, and *Mycrophysa*), we observe the usual ocelli, found, with rare exceptions, and the total exclusion of one family, the *Capsini*, throughout the heteropterous *Hemiptera*. This family, compared with the former, is of very limited extent, and the insects are generally much smaller. The very beautiful *Lygæus equestris* is a British insect, although extremely rare,—for we believe only two specimens have yet been discovered, one of which we are lucky enough to possess: it is about six lines long; of a brilliant vermilion colour, varied with black, and having a limpid white spot in the centre of the junction of the hemelytra. *Pyrrhocoris apterus* (also a British insect) is gregarious, and offers an uncommon anomaly in frequently existing only in a wingless state, but exercising, even thus, all the functions of the imago. Its apterous condition must not, therefore, lead us rashly to conclude that it is an imperfect insect; it may have, and evidently, from the results, has, undergone all the completing internal developements, which from some cause, not yet understood, have been thwarted in their external exhibition. This circumstance, however, is not peculiar to this insect only among the *Hemiptera*, and we observe it in the orthopterous portion of our *Neuroptera*. In the *Hemiptera*, it displays itself in *Myrmus miriformis*, and *Actorus popularum* Fab. of the preceding family; and we shall find it again occurring in the *Reduviidæ*.

The most remarkable form, perhaps, among the *Lygæi*, is the *Microphysa pselaphoïdes* Burm. which has only abbreviated elytra, and is totally deficient in its interior wings.

(115.) Our second circle, the REDUVIIDÆ, consists, we expect, of the following three families: — 1. the *Capsini*; 2. the *Tingi*; and, 3. the *Reduvii*. Possibly, *Cimex lectularius* may form a fourth family belonging to this group. All these insects we shall find considerably more rapacious than those of the preceding circle; and although in *Capsus*, and its immediate affinities, it is not quite so strongly instanced, so do they, doubtlessly, on this account, form the connecting link between the two. In the *Capsini*, we observe throughout the total absence of ocelli; and, although there are but few distinct generic forms in this family, their deficiency is fully compensated by an overwhelming preponderance in species. The insects are small, and have long and slender antennæ and legs, which, in *Miris*, are longer than the body. The *Harpocera Burmeisteri* Curt., in the male, is remarkable for the apical contortion of the second joint of the antennæ. In *Heterotoma*, the second joint of the antennæ is much enlarged, and very much compressed: and in the little plump *Orthonotus*, the posterior femora are considerably thickened, and the tibiæ and tarsi exceedingly slender, and twice the length of the femora; and this last genus possesses the faculty of leaping. From the *Capsini* we pass to the *Tingi*, the second family of this group; and here we observe remarkable differences of form; the most typical being exceedingly depressed, their whole external integument and hemelytra frequently consisting of a closely reticulated semitransparent substance, which, in *Galeatus* Curt., is extremely pellucid. Although the antennæ differ from the description given above in the definition of the group, it is very evident, from the structure of the rostrum and of the head, that these insects have a close affinity to the *Reduvii*. It will admit of subdivision into those which have simple anterior legs, which constitute the true *Tingi*, comprising also *Aradus*, which is a sub-cortical genus; *Aneurus*, another sub-cortical form, in which the superior wings are wholly membranaceous; and other allied insects. In these, the wings usually cover the abdomen; but in the second division, in *Syrtis*, we observe the sides of the abdomen dilated, as we had occasion to notice in *Coreus*; and in *Macrocephalus* there is an enlargement of the scutellum, as in the *Scutati*, equally covering the superior wings, and which likewise corroborates the observations we there made; for we find these wings also, in this genus, membranaceous, excepting their slight lateral portion; all the rest being wholly protected by the scutellum. These two genera present us also with a character and structure; viz. their raptorial anterior legs, which, as far as habits can confirm, substantiates their position as being very proximate to the raptorial *Reduvii*. These legs consist of a largely swollen femur, into a groove beneath which the curved tibia fits. The object of the enlargement of the femur is to give room for the exercise of the powerful muscles that contract and close the limb, whereby the insect is enabled to seize and retain its comparatively strong prey, and which it then feeds on at leisure. If the *Cimex lectularius* enters this group, it is probably in this vicinity that it should be inserted. To *Aneurus* it is allied by its very depressed form, although amply distinguished from its antennæ being attenuated at their apex. There are few persons who are not acquainted with the bed bug, which is the insect we are now speaking of. It excites, perhaps, too much disgust to interest any but zealous entomologists; and yet it would be found, upon examination, to be a curious insect. Like some few other *Hemiptera* we have previously mentioned, it is always deficient in wings; although Londoners, in particular, can well attest, that this does not, in the slightest degree, impair its powers of propagation. The family of the *Reduvii* will now occupy us. This very numerous concourse, being the typical family of the group, are consequently the most rapacious. Their very aspect seems to indicate predatory instincts: their small head, prominent eyes, frequently short, robust, and raptorial anterior legs, and lengthened posterior ones, combined with a compact but long body, convey an idea of agility and strength, which seem, in some respects, analogous to the concurrent structure in the feline *Mammalia*; and many of them are equally nocturnal in their habits. In one genus, in particular, the South American *Conorhinus*, there is as strong a disposition as in *Cimex* to feed upon blood; for we find that it frequents houses, and attacks sleeping persons. This genus also exhibits, perhaps, the largest species of the family, the *C. megistus*, being frequently more than an inch and a half long: indeed, this family contains generally large insects. Although, perhaps, the normal number of joints to the antennæ throughout the heteropterous division of the *Hemiptera* is not to exceed five, we here frequently find a divergence from it,—in some extending to eight; and in one in particular, the *Hammatocerus*, the number reaches thirty,—the usual second joint being subdivided into these numerous articulations. Some species are remarkable for producing, under irritation, a chirping noise, like several of the *Longicorn Coleoptera*; and one, the *Prionotus serratus*, has been observed to give an electric shock. The accuracy of this, Burmeister doubts; and, indeed, it does appear very startling; yet Messrs. Kirby and Spence mention it upon such high authority, that its veracity it would be temerity to impugn. Their words are*, "The late major-general Davis, of the Royal Artillery, well known as a most accurate observer of nature, and an indefatigable collector of her treasures, as well as a most admirable painter of them, once informed me, that when abroad, having taken up this animal (*Reduvius serratus*), and placed it upon his hand, it gave him a considerable shock, as if from an electric jar, with its legs, which he felt as high as his shoulders; and, dropping the creature, he observed six marks upon his hand, where the six feet had stood." We expect the bug must have been recently feeding upon the *Gymnotus electricus!* Although there is considerable uniformity of general contour in these insects, some, nevertheless, present peculiar differences of structure; for instance, *Notocyrtus* has its thorax exceedingly inflated above; and the before-mentioned *Prionotus serratus* has the prothorax longitudinally compressed into a raised semicircle extending over the scutellum, the edge of which is notched; whence it is called in the West Indies the "wheel bug," and it also thence derives its specific name. The transverse suture of the head and thorax, in many of these insects, is very like what we see in the coleopterous genus *Paussus;* and one of the latter, the *P. armatus*, in the spine of its head, has an analogy to the spine upon the head of the *Nabis lividus* of Latreille. A further resemblance between the two is the ocelli said to be observed in several species of *Paussi.* In some,—*Pirates*, for instance,—the anterior and intermediate tibiæ are dilated at their apex beneath, into a vesicular sole; this structure gives them a facility for adhering with greater tenacity to what they wish to attach themselves. A small and very elegant species of *Holoptilus*, from New Holland, has its antennæ densely fringed with hair, and the posterior tibiæ still more thickly so with longer curled hair; which, from that peculiarity, look exceedingly like the legs of the genus *Ancyloscelis* among the bees. The refinement of modern science will, probably, form this into a new genus; the proportions of the two last joints of the antennæ differing from the typical *Holoptilus*, the penultimate joint being curved, and the terminal one clavate, and inserted before the apex of the preceding. *Coranus subapterus*, and *Prostemma guttula*, which are British insects, offer us instances in this group, also, of perfect insects in a sub-apterous state. There are three genera in this family which we must still notice, from their departing considerably from the usual form of the insects contained in it. These are *Emesa*, *Cerascopus*, and *Ploiaria*, which are very elongate and slender,—indeed, perfectly filiform. The two former occur in America, and the latter in Europe. Their anterior legs are raptorial, and, we believe, rarely used in progression, but kept vibrating with the antennæ, which are exceedingly slender and angulated: the intermediate and posterior legs are also very long; and it is upon them that these insects stalk about seeking their prey. They are found chiefly in houses.

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* Introd. to Entom, i. 108.

(116.) Our next group, the NEPIDÆ, will detain us but a few moments. The genera differ considerably from each other in form: thus, *Nepa* itself is broad, ovate, and quite flat; *Ranatra*, very elongate and cylindrical; *Belostoma*, nearly ellipsoidal; and *Naucoris*, almost circular, and slightly convex. These insects all inhabit the water, as all of the preceding were occupants of the land. They are very predacious, which is sufficiently evinced by their powerful anterior predatorial legs. It is probable that the *Galgulini* should form a component portion of this group; for, excepting that their posterior legs are cursorial instead of being ciliated for swimming, they very closely resemble *Naucoris*. From structure, as we observe above, they are distinctly land, as the others are water insects, and inhabit the banks, forming holes in the ground, where they lurk for their prey.

(117.) *Velia*, *Gerris*, and their allies, appear quite as typical of a group as any of the preceding. Although much resembling *Ranatra* among the last, and *Emesa* among the *Reduvii*, they possess peculiarities of structure and habits which at once distinctly estrange them from both. In the first place, they inhabit the *surface* of the water, where they run with considerable velocity; and thus appear a sort of analogy among haustellate insects to what we observe in *Gyrinus* among the natatorial *Coleoptera*. The relative proportions of their legs differ; thus, in *Velia*, *Gerris*, and *Hydroessa*, the intermediate legs are the longest, and the anterior usually kept bent:

in these, the head is short, and the antennæ nearly as long as the anterior legs. This is the case also in *Halobates*, which is an extremely remarkable insect, found only upon the surface of the sea, within the tropics, and at a considerable distance from land. They must, necessarily, be exposed to the worst vicissitudes of a sea life, being unprovided with wings, to accelerate their transposition from place to place. It is also a very curious subject for speculation, what may be their peculiar economy and habits, and where they may deposit their eggs. Of the other genera, all are British. The pretty little *Velias*, with their black bodies studded with white spots, and the gay crimson of their abdomen, present a pleasing appearance upon brooks; and the extremely minute *Hydroessa* has all the appearance of a microscopic aquatic *Pepintoma*. [(114—117.) W.E. Sh.]

(118.) The CICADÆ, or singing insects, have been already shown to constitute the sub-typical group of the present order. Like the *Cimicides*, they have a suctorial proboscis folded downwards and reposing on the breast; but their wings do not cross each other, but are deflexed when the insect is at rest. Their antennæ, instead of being at once conspicuous, and ending in well-defined joints, are so short that they often appear as wanting. On a close examination, however, two fine hairs or bristles are discovered, placed close to the eye: these bristles stand upon short and thick stems, which are more or less jointed at the base. The wings are always distinctly nerved; the upper pair being stronger and thicker than the lower, and either transparent, or ornamented with colours. The head is usually very large, thick, and transverse; — that is, much wider from side to side than from the front to the back; the forehead consequently is uncommonly broad, and this throws the eyes very far apart: between the true eyes, by the aid of a glass, three little ocelli, or false eyes, will be discovered *, shining like morsels of glass; while the bugs have two of them only. The legs deserve great attention; with very few exceptions, the hinder pair are remarkably longer than the others, and are formed for leaping and for defence. The common froghopper, called by some the cuckoo spit (which in its grub state lives in a drop of froth upon plants), is a small but familiar example of this order, and easily procured in summer. The hind legs, it will be perceived, are not only very long, but armed with sharp spines, much in the same manner as those of the grasshoppers. Every body knows what prodigious leaps are taken by these little insects, when disturbed; and if one is captured, and held between the fingers, the struggles it makes to get free will show the effect which the spines would have on any other occasion. We have said that the upper or superior wings are either clear, or opake and coloured; this colouring, however, is not farinaceous, except in one family (*Flatidæ*), where the wings seem covered with a white powder. It is by this, or similar insects, that an easy passage is formed to the *Lepidoptera*, and the two orders brought into immediate conjunction.

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* Excepting in the *Membracidæ*.

(119.) The natural habits and economy of the *Cicadæ* are very different from those of the *Cimicides*. The majority of the latter are predacious insects, living upon the juices of others, which they seize by surprise when hunting among foliage; and having wounded their prey by their proboscis, suck the blood. The *Cicades*, on the other hand, mostly live upon the juices of plants, which they pierce in the same way; such, at least, is the case with nearly all those found in Great Britain: but there are very many (more especially those which may be considered typical), which have the fore legs raptorial; that is, formed for seizing, similar to the *Mantidæ*, and other families which are known to live upon smaller insects: in all such groups, these legs are very thick and robust, and are armed with sharp spines, which serve to secure and even to kill their prey. The common Italian cicada shows a full developement of this structure; and unless it be supposed that the insect uses these feet to press out the juices of plants, we may fairly suspect that they are employed in seizing and wounding smaller insects. There can be no doubt that these vegetable suckers tend, in general, to the healthiness of the plant they feed upon, although their numbers frequently cause much injury. They are, in fact, the phlebotomists of vegetables; attacking them when in the full vigour of their growth, and feasting upon that superabundance of sap with which they then abound. The plant lice, or *Aphides*, are the most expert suckers of any of their tribe. The little family of *Membracina*, which represent these insects in Tropical America, are found clustered on the rich luxuriant shoots of the Guava and other fruit trees, busily employed in tapping the stem and sucking the juice.* As to the geographic distribution of the tribe, we have very few in Europe, and these are mostly of a small size: the rest are distributed in the hot latitudes of the Old, but chiefly in those of the New World. The pre-eminent types (*Cicadidæ*), as is usual throughout nature, are universal, and one has been discovered of late years in the New Forest in Hampshire. Many family groups, and nearly all the natural sub-genera, are restricted to certain geographic limits. Several of these are interesting, either from the singularity of their form, or their habits, the chief of which will be subsequently noticed.

(120.) The affinities of the *Cicadæ* to the *Cimicides* on one hand, and to the lepidopterous order on the other, have already been intimated; but so much of error, of late years, has been introduced about "orders" in the reigning systems, that we shall here again return to the subject, by quoting the opinion of others. The union of this tribe to the typical *Hemiptera* is so obvious, that it has been well observed, "the affinity cannot be disputed, without a distortion of some of the most evident facts in natural history, being accompanied with an utter disregard to the authority of all entomologists."* The same author also states that "the transition is effected through the medium of the *Notonectidæ* (or boat flies), and other *Hydrocorisæ* of Latreille; which coincide with the *Cicadides*, in the small developement of their antennæ and conical rostrum; and with the true (or typical) *Hemiptera*, in their rostrum being frontal, their elytra coriaceous, and their body generally depressed. With proper caution, however, the same learned author, not having entered upon the necessary analysis, observes, "it would at present be very blamable in me to pretend to determine whether these insects (the *Notonectidæ*) come nearest to the hemipterous or homopterous (or *Cicades*) type; but I may observe that the probability is on the side of the latter supposition, since the genus *Ranatra* bears a strong analogy to the *Ephemeræ*. We perceive, however, the wings of the *Hydrocorisæ* becoming gradually more coriaceous, or rather corneous, and opake; we perceive them crossing one another more and more, in order to make room for the enlargement of the scutellum, which, with the true ocelli, and quadri-articulate rostrum, is the typical character of the true *Hemiptera* (or our *Cimicides*)."† Our analysis of this group has, in a great measure, confirmed these views: we consider the *Notonectidæ* as one of the aberrant divisions of the order; and, from its obvious analogy to the natatorial birds and quadrupeds, we should term this division the natatorial family of the *Cicades*. Now, as the *Nepidæ* are obviously the corresponding group among the *Cimicides*, it follows that this is the point of junction between the two; although the precise sub-genus by which this passage is effected, has not yet been ascertained. The second affinity regards the connection of the *Cicades* (the *Homoptera* of some authors) to the *Lepidoptera*; and here, again, we shall make use of the same authority in support of own decided opinions on this point. "The immediate means of transition from homopterous insects to the lepidopterous, is probably exemplified in the genus *Aleyrodes* of Latreille, the *Tinea proletella* of Linnæus, and the *Phalène culiciforme* of Geoffroy. The history of this minute insect is the subject of one of Réaumur's most interesting *Mémoires;* and when we learn that it undergoes an obtect" (or complete) "metamorphosis; that in its pupa state it is inactive, and in its adult is covered with a farinaceous powder; we are as little surprised that this great physiologist should have considered it to be lepidopterous, as that Latreille, reasoning from its articulated rostrum, should have pronounced it to be homopterous. We are only astonished that the latter should have adopted any arrangement which would lead us to fancy that he believed his observations on *Aleyrodes* contradicted those of Réaumur." It is thus, as our author truly observes, "that the greatest naturalists, in every department of nature, are often right and wrong at the same time, with respect to the same animal; and that a person in search of natural affinities, has generally reason to conclude himself to be perfectly correct, when he has combined all their positive observations, and rejected their negative inferences." The farinaceous wings of the *Flatidæ*, subsequently noticed, induced our author to pronounce them as "manifestly bearing a distant affinity to certain extreme *Lepidoptera*." These insects, indeed, so completely resemble moths, that they may be justly called the *moth cicadas.*

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* Mr. Westwood attributes the first announcement of this fact to an author who mentions it *ten years* after it fell under our own observation in Brazil; and then flippantly says, I was ignorant of the circumstance.

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* Hor. Ent., p. 376.

† Hor. Ent., p. 377.

(121.) The primary groups under which we shall now arrange the cicadas, will be considered in the light of families, and may be thus concisely enumerated:— 1. The true *Cicadidæ*, or singing insects; so named from their musical powers.—2. The *Flatidæ*, or moth-like cicadas, having their wings generally covered with a white farinaceous powder.—3. The *Centronotidæ*, or spined cicadas, remarkable for their small size, and the spines upon their bodies.—4. The *Notonectidæ*, or water cicadas, vulgarly called boat flies: these are few in number, and, as their name denotes, are aquatic. The

5th type is uncertain, and may possibly be represented by such insects as have the greatest resemblance to the *Coccidæ*.

(122.) The true cicadas (*Cicadidæ*) stand at the head of the tribe, as the pre-eminent typical family: they vary considerably in size; and comprise, with but two or three exceptions, the largest insects in the whole tribe yet discovered, as well as some of the smallest. Amid this diversity, there is one character, however, by which nearly the whole may be recognised,—that of having the antennæ placed directly in front of, or *before*, the eyes. The front of the head is always swollen as if inflated; and these inflated parts are always crossed by very fine transverse or horizontal lines, not unlike the plaiting of a shirt frill. Of what use this singular structure is to the insect, we know not; but it is so generally prevalent, that we may attach some weight to its variation. There is a considerable variation in the neuration or nerves of the wings: some groups have these members transparent; while in others, the upper or larger pair are opake, and ornamented with bands, spots, and other markings; these differences give rise to further separations or sub-families, each of which seem to possess some peculiarity of economy; hence we can easily discriminate two leading divisions;— 1. the *Cicadinæ*, or singing group; and, 2. the *Cercopinæ*, or hopping cicadas.

(123.) The singing cicadas (*Cicadinæ*) are conspicuous for their bulk, and have been long celebrated for their economy. Many of the exotic species, when their wings are expanded, measure six inches in extreme length,—a size superior to that of many of the humming birds. The body is remarkably thick and robust; and they fly with such rapidity, that the eye cannot follow them. With the exception of one species, *Cicada Anglica*, these insects are unknown in our misty islands, are children of the sun, and love to bask in more genial climates. As this power of rapid flight is one of the great peculiarities of these creatures, so the members by which this is effected deserve attention. The wings are long, and pointed towards the end,—a form peculiarly adapted for swiftness: in general, they are clear and transparent, but some few from India and Africa have the anterior or largest pair opake and coloured; in both, however, they are marked by regular distinct nerves, which are divided into large cells towards the thorax, and into numerous smaller ones at the edges. But what more especially distinguishes these insects, when alive, is their faculty of emitting a very loud, and—according to some authors—a not unmusical noise. It may be readily supposed that a power so very unusual among insects, would excite great attention; and we accordingly find that the cicada was one of the most celebrated insects of antiquity. Philosophers did not disdain to write upon it; while the fictions of the early poets invested it with perpetual youth, and exalted it to the rank of a demigod. We find the cicada perpetually extolled as an emblem of constant gaiety and uninterrupted happiness, as little cheerful beings, "beloved by gods and men." Anacreon, in his celebrated Ode to the Cicada, describes in glowing colours the uninterrupted felicity of this creature. The Athenian patricians wore golden ornaments representing the cicada in their hair, to denote their national antiquity, or to intimate that, like these insects, they were the first-born of the earth. It has been ingeniously remarked, that, in the infant state of music, man seems to have preferred the natural sounds of some animals to those of their uncouth instruments, and that hence arose the extravagant praise bestowed upon the cicada. The ancient *Locri*, a people of Greece, are related to have been so charmed with its song, that they erected a statue to its honour. The following fable, relative to the same people, is too poetic to be passed over. A certain musician of Locris, contesting with another, would have [illegible] the chance of victory, by the breaking of two [illegible]gs of his lyre, but at this critical moment a cicada [illegible] to his aid, and resting on the broken instrument, sang so well, that the Locrian was declared victor. His countrymen, in testimony of their gratitude, erected a statue to the insect. There is a beautiful antique gem, which we saw either at Rome or Florence, commemorating this supposed event: it represents the figure of the player, with the insect perched upon his lyre. No author we have met with has given a better idea of the singing of a cicada, than old Marcgrave, who says its tune begins with *gir*, *guir*, and continues with *sis*, *sis*, *sis*. This, we can affirm from experience, exactly expresses their long-continued and monotonous chirp. In the olive plantations of Italy and of Sicily, and those which cover the beautiful plain of Athens, we have heard innumerable hosts of these merry creatures during summer; and the noise is so loud, that it may be heard at the distance of half a mile. Strange to say, however, the traveller is not able to see one of these creatures, although hundreds surround him on all sides: while thus recreating themselves, they invariably perch on the branches or stems of trees, some distance from the ground; while their plain dusky colours assimilate so closely to that of the bark, that the most practised eye can scarcely detect them. It generally happens that the concert is begun by one, who seems to have more power than the rest: he commences with all his might; and in a minute or two, all the surrounding trees seem to join in full chorus. Many fables among the ancients, and much erroneous matter by the moderns, has been published regarding the means by which this singing is produced. Réaumur, however, with his usual patience and accuracy, solved the difficulty: he discovered two large muscles, which at their point of union formed a space almost square; by moving these backwards and forwards, he discovered, to his no small astonishment, that he could make a cicada sing that had been dead some weeks! The sound is emitted through two large apertures, one on each side of the body, which are partly covered by valves: in some species from Brazil, these apertures are extended to the upper side of the abdomen, where they have a considerable resemblance to those in the pipes of an organ. The female cicada, however, is entirely without this apparatus; hence the old Greek adage that the *Cicadæ* were particularly happy, because they had silent wives. Aristotle mentions them as delicious food; but maccaroni has long supplanted them in the estimation both of the modern Greeks and the Italians.

(124.) The second division of this family is composed of the CIRCOPINÆ, or jumping cicadas. They are all of a very small size; and very different, in their external appearance, to the last: they have no musical powers; and their long hinder legs are saltatorial, or adapted for leaping. These little creatures are abundant in all verdant situations during summer, particularly among the foliage of trees, and high grass. The larva or grub, as before observed, has the singular property of producing a frothy liquid, precisely like human saliva, in which its soft tender body is secure, and in the middle of which it constantly resides: hence the vulgar names of *cuckow spit* given to the larva, and *froghopper* to the adult or perfect insect: the *ocelli*, or simple eyes, in this group, are only two; and the superior wings, called by some the *elytra* (we think improperly so), are nerved in a very different manner to those of the true cicada. The genus *Ledra* is the only one wherein the thorax is ornamented with horns or other excrescences; and this appears to represent, in its own circles, the *Centronotidæ*. The foreign jumping cicadas are innumerable, and are so little known, that out of more than seventy species we discovered in South America, we believe that not one half have been described.

(125.) The moth cicadas, or the FLATIDÆ, compose the second great division or family of the tribe. As the *Cicadidæ* form the typical, so this constitutes the *subtypical* group; and every one can perceive how beautifully it represents the order of *Lepidoptera*. They are, in fact, cicadas disguised as butterflies and moths: like these latter, their wings are very broad, obtuse, and, in many genera, covered with minute scales, which appear to the eye like a fine powder. Even in such as have not their wings so covered, this powdery substance is found upon the body, or on other parts: here, however, the resemblance ceases, so far as the structure of the two orders are concerned. The moth cicadas are nearly all confined to the tropics of the Old and New World: their representatives in Britain are the small aberrant genus of *Issus* Fab. and [illegible] Leach; these live in thickets, and may be found along the hedges in summer. The form [illegible] and the position of the antennæ, joined to the [illegible] the wings just alluded to, offer the best and [illegible] prevalent characters for this family. We have seen that the front of the head, in the *Cicadidæ*, is swollen, or at least convex; but in these insects it is either perfectly flat, as if cut off, or divided into two concave hollows, at the bottom of which, immediately beneath the eye, is placed their very small antennæ: the front is also destitute of those fine horizontal lines so prevalent in the first great division (*Cicadiadæ*).* A remarkable exception occurs to the generally truncate shape of the head, in the genus *Fulgora*, where this part is lengthened and swollen to an enormous size, more analogous to the snout of an elephant, or the horn of a rhinoceros, than any thing else. This structure, however strange, is in strict accordance with one of the most prevalent laws of nature. The *Fulgorinæ*, in the circle of the *Flatidæ*, seems to be the rasorial type in regard to birds, and the thysanuriform with reference to insects; both of which, as is well known, are remarkable for the appendages which adorn their heads, which are frequently so strange as to give them the most grotesque appearance. But the analogies of the *Fulgora* do not rest here: on its lower wings we have the eye-like iridescent spot of the rasorial peacocks, as if Nature intended to show how beautifully she could make a bird and an insect represent each other. Gallinaceous birds, pachydermatous quadrupeds (like the elephant), stag beetles (*Lucanidæ*) among *Coleoptera*, are always the largest of their respective groups; and consequently *Fulgora*, which represents all these, is not only the largest of the moth cicadas, but is equal in size to the most bulky of its own tribe. We had no intention of touching upon this analogy, beautiful as it is, but we recollected that some explanation was necessary for deviating so much from the usual arrangement of this group. The *Fulgoræ* are called lantern flies; and, if what has been said of them be correct, the name is peculiarly appropriate. Madame Merian, well known for her work upon Surinam insects, relates an amusing anecdote about the great lantern fly of that country. It seems that she had caught several of these insects during the day, when they emit no light; and being ignorant of their possessing this property, she put them, with some leaves, into a box, which was laid upon her bedroom table. In the middle of the night, her captives, finding themselves debarred from their usual nocturnal excursions (for these insects repose during the day), began to buzz about and made every effort to escape. The noise thus produced awoke Mad. Merian, who, finding it impossible to sleep with all this fluttering, got up and opened the box to release her prisoners. What was her surprise at seeing it filled, as she thought, with large sparks of fire!—in her momentary fright, she let the whole fall to the ground: the insects, thus released, began flying about the room in all directions, like so many moving candles. Our authoress goes on to state, that by the aid of two of these living lights, she was able to read the smallest print. Another conspicuous species, *F. Candelaria*, although much inferior in size, is found in India; but Europe possesses no such wonders. There is, indeed, a small insect called *Fulgora Europæa*, but which is of a different genus to the true lantern flies,—

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* It may be as well to observe here, that Dr. Leach has mistaken the mode of insertion of the antennæ in his genus *Cercopis*, and has thus made his third stirps both erroneous and artificial.

these latter being exclusively tropical. Two or three small but curiously shaped genera, as *Delphax*, &c., are placed at the end of this family, although their affinities are at present uncertain.

(126). The horned cicadas, or the CENTRONOTIDÆ, constitute our third great division. The whole insect world cannot produce such extraordinary and eccentric shapes as are exhibited among these little creatures: were they of a moderately large size, any one might be exhibited as a monster, and the most fanciful imagination would be sorely taxed to invent any thing more grotesque than Nature herself has produced. The *Centronotidæ*, with very few exceptions, are exclusively found in the forests of Tropical America, where they live, frequently in little societies of their own, upon the young shoots of plants, which they probe and suck as the *Aphides* do in Europe; for these latter insects, so far as our own personal observations have gone, are not found in these regions. This fact affords an additional reason in support of our belief that these two families are analogous, and that both are types of the ruminating quadrupeds, in other words, *rasorial*. How little the *Centronotidæ* are known, may be gathered from the fact, that out of near a hundred species found by us in Tropical America, not more than one half are described in books. Yet, abundant as those insects are in those regions, which may be termed their metropolis, only two species appear to inhabit England. One of these, however, *Centronotus cornutus*, is not uncommon, and gives a very good idea of the whole family. Its head and breast are larger than all the rest of the body; the former is thick, broad, and truncate, but of a very different form to any among the *Cicadidæ* or the *Flatidæ*. The chief singularity, however, lies in the thorax, which is enormously developed: on each side arises an acute spine, pointing outwards, so as to resemble the horns of a bull, or ruminating quadruped; while the hinder part is prolonged into another spine parallel with the body, and which it is obviously intended to protect: the wings are transparent, and, both in their form and neuration, much more resemble the typical cicadas than they do the *Flatidæ*. Who that looks upon this singular little creature, will not be immediately reminded of a bull? The truth is, that the mind of man is instinctively prone to comparison; for the imagination will frequently associate together two or more things, having not a single property in common, yet so shaped as to suggest the same ideas. No better proof of this can be mentioned, than the resemblance which people very often imagine they can trace in the faces of animals (particularly sheep) to those of their acquaintances. Now there is as much diversity of physiognomy in one race as in the other; yet the analogy between them is so remote, that, although it may strike the imagination with irresistible force, it would frequently be difficult to state the reason of the similitude. Now, this is precisely the case with those remote analogies, or representations. In the present case, however, we have more certain grounds to go upon. A glance at some of the Brazilian types of this extraordinary family may here be taken. The largest species yet discovered (*Membracis spinosa* Fab.), in its general shape, exactly resembles a very large thorn from the stem of a rose tree; and the spine upon its thorax is so formidable, that we have had our fingers severely wounded in attempting to capture it. Another (*Bocidium globulare*) has a little fanciful diadem of round balls and spines rising from the thorax; and this is so spread over the insect, that every part of its body is protected. In another group (*Polyglypta*), all these spines disappear, and the thorax is lengthened out in front into a snout-shaped process, as long as the whole body; thus giving to them all the aspect of lantern flies. Another genus (*Darnis*) might at first be taken for a coleopterous insect; for it is entirely cased over with a hard shell, without any external appearance of wings, which lie concealed beneath, as in *Scutellera*. In these cicadas, also, the head, although broad, is particularly short, and is so bent down as to be almost hid: the antennæ are shaped like those of *Cercopis*;

but instead of being in *front* of the eye, they are placed in a hollow *beneath* it, similar to the *Flatidæ.* Such are the primary, or typical, characters of this family; but to attempt the definition of all those intervening links by which it is connected with the preceding, would far exceed our limits. There are several small groups, peculiar to India and Australia, to which Nature has obviously assigned an intervening station; for all her paces are slow and measured: if they appear otherwise, as they certainly do in some few instances, we must set it down to our own ignorance of her productions, rather than to her departure from her usual principle of *gradual* developement.

(127.) The fourth family of this tribe appears composed of the NOTONECTIDÆ, or boat flies, constituting the natatorial or swimming type of the whole group. Our reasons for including these insects in this tribe, rather than in the last, cannot be entered upon in this place. It will be sufficient if the reader is made acquainted with the general form of these insects, and their peculiar habits. For this purpose, let him fancy that a minute insect, whose shape immediately reminds him of the British *Centronotus Genistæ,* but whose hinder feet are formed for swimming, he will thus have a very good idea of the general form of the boat flies; and more especially of the genus *Ploa,* or the minute *Sigara* of Dr. Leach. Without touching upon their other peculiarities, it will be sufficient to state that the *Notonectidæ* are immediately known by their long hinder legs, the tarsi of which are so compressed and fringed as to resemble oars; these enable the insect to swim with great rapidity. The shape of the body is thick and triangular; and the outer half of the superior wings fold over each other. Dr. Leach very properly divides this family into two groups; one (*Notonecta*) having the shield (*scutellum*) large; the other, as in *Corixa,* being entirely without this part. On a fine summer's day, they may be observed basking in the sun, close to the surface of the water, in clear ponds or ditches; here they will continue immovable for several minutes, with their hinder legs stretched out, in the same attitude which a boat's crew assume when ready for a sudden start. The *Notonectidæ*, like the *Nepidæ* among the bugs, are rapacious,—living upon small insects, whose juices they suck. The attitude we have just described, although apparently one of listlessness, is really that of extreme watchfulness: the insect is lying in wait for its prey; and the moment a luckless wanderer passes within reach, it darts upon it with the utmost rapidity, and is out of sight in a moment. Another singular habit belongs to these insects: they not only swim, but repose, upon their backs; that is, with the under side of their body turned uppermost: this is a wise provision of Nature, and admirably suited to the nature of their pursuits;—by resting in this position, their eyes are directed fully to that quarter where they are to look for their prey; while, if they assumed the usual position of other insects, they would gaze upon objects either *upon* the surface, or *above* it.

(128.) Let us now look to the analogies which these insects possess to other classes of beings. The *Notonectidæ* are clearly an aquatic type, and offer an immediate point of union with the typical *Hemiptera;* their close affinity with the *Nepadæ* is admitted by all writers; and we have frequently observed, both among annulose and vertebrate animals, that one of the transitions of nature is made by an aquatic group. All natatorial types, among birds, represent the shrikes and the fly-catchers, who have the peculiar habit of watching for their prey from a fixed station, and seizing it, not by pursuit, but by surprise, just as the insects now before us. Natatorial types, moreover, have always the largest heads; witness the hippopotamus among the pachydermatous quadrupeds, the whale among the *Cetacea,* and the *Hesperidæ* in the circle of diurnal butterflies.

(129.) In regard to the remaining family of the present tribe, we can say but little. If we merely looked to those genera which showed the greatest deviation from the families already enumerated, we might suppose that *Asiraca* or *Livia* would probably form part of another great division, or that some of the lanigerous genera, resembling *Coccus*, would here intervene; but we do not, at present, venture to act upon such vague suspicion, and shall therefore leave this part of the series for future investigation.

(130.) Having now gone through the two typical groups of the order *Hemiptera*, we shall at once proceed to the three others, which appear to form the aberrant divisions,—namely, 1. the *Aphides*, or plant suckers; 2. the *Coccides*, or meal bugs; and, 3. the *Aleyrodes*.

(131.) The Aphides, or plant lice, as we have already observed, are all of a very small, and often minute, size, and live for the most part in societies. Three of these families are represented by the Linnæan genera *Chermes*, *Aphis*, and *Thrips*; while that of Leach's *Eriosoma* is a type of the fourth. Of the *Chermes*, we possess, comparatively, but few species; they are found on the leaves, young shoots, and bark of different plants: in their larva state, they seem to exhibit a considerable affinity to the *Coccides*, or plant bugs; and we think it is to that family, rather than to this, that some of them really belong: like the *Coccides*, many of them are coated, particularly towards the tail, with a flocculent or cottony substance of a white colour, and of a clammy tenacious nature, which exudes from the pores of the animal. These flocculent cotton-like filaments are very conspicuous in the *Chermes Alni*, which may be found, during summer, on the leaves and shoots of the alder tree. The larva, as described by Dr. Shaw, is entirely covered about the hinder part by thickly fasciculated heaps of viscid down or cotton, which, if purposely rubbed off, are quickly reproduced by the animal, which secretes the white fibres from large pores placed in a circle at some distance from the vent. These larvæ, or grubs, are gregarious; often appearing in such numbers on the tree, that the whole of the shoot they are upon appears covered with white cotton, which, if touched by the finger, separates into distinct tufts,—an effect produced by the animals being suddenly disturbed, and then moving in all directions. When this cotton is brushed off, the larva appears of a pale green colour, varied with black spots. When arrived at its complete or perfect state, by casting its pupa skin, it is entirely green, with transparent wings. If disturbed, it leaps with great agility, frequently flying at the same time.*

(132.) The true APHIDES, or plant lice, are well known to infest the early buds of the rose tree and other plants, upon which they continue to multiply during the whole of summer. The habits and economy of these singular insects are so well known, that we shall here chiefly confine our remarks to their external characters, and their general history. The body is thick, fat, and round, having, towards the end, three horn-like bristles, one of which is on each side, the other at the vent; these terminate in a little knob, and are moveable; their use, however, does not appear to have been detected: the head and eyes are very small,—the latter prominent; while the antennæ, unlike those of all the other families, are as long as the body, slender, filiform, and composed of seven joints: the wings also differ greatly from all other hemipterous insects; they are perfectly transparent, and distinctly veined,—assimilating, in short, to those of the hymenopterous order. Like those insects, they have likewise the power of forming a honey-like secretion from the vegetable juices upon which they subsist, although by a totally different process. In most species of the *Aphides*, both males and females acquire wings at certain seasons; but in this respect they are subject to great variation,—there being some males and some females that never have wings; again, there are some females that become winged, while others of the same species do not. The *Aphides* are the most defenceless of all insects, for they can nei-

* Shaw, Gen. Zool., vi. 1187.

ther fly nor run sufficiently fast to avoid danger: they seem never to make use of their wings, but for the purpose of finally leaving the little society in which they were born, and establishing for themselves a distinct colony; while the feet, although perfect, are remarkably slender, and only enable the animal to walk very slow.

(133.) The honey-dew, according to the observations of the late Mr. Curtis, is chiefly, if not entirely, occasioned by these insects. "Were a person," observes our ingenious author, "to take up a book in which it was gravely asserted that in some countries there were certain animals which voided liquid sugar, he would soon lay it down, regarding it as a fabulous tale, calculated to impose on the credulity of the ignorant; and yet such is literally the truth. The superior size of the *Aphis Salicis*, or willow plant-sucker, will enable the most incredulous observer to satisfy himself on this head. On looking stedfastly for a few minutes on a group of these insects, while feeding on the bark of the willow, a few of them will be perceived to elevate their bodies, and a transparent substance evidently drop from them; which is immediately followed by a similar motion, and a discharge like a small shower, from a great number of others. On placing a piece of writing paper under a mass of these insects, it soon became thickly spotted; holding it a longer time, the spots became united from the addition of others, and the whole surface assumed a glossy appearance. I tasted it, and found it as sweet as sugar. I had the less hesitation in doing this, having observed that wasps, flies, ants, and insects without number, devoured it as quickly as it was produced. In the height of summer, when the weather is hot and dry, and the *Aphides* are most abundant, the foliage of the trees and plants upon which they reside, is found covered by this substance, generally known by the name of *honey-dew*." After combating the opinions that this was either exuded from the plants, or had fallen from the atmosphere, Mr. Curtis observes:—"As far as my own observation has extended, there never exists any honey-dew but where there are *Aphides:* such, however, often pass unnoticed, being hid on the under side of the leaf. We have some grounds for believing," Mr. Curtis adds, "that a saccharine substance, similar to that of the *Aphis*, drops from the *Coccus* also.

(134.) The astonishing fecundity of these insects has no parallel in the animal creation. In summer, the young are produced alive from the body of the parent; but in autumn, the female deposits *eggs* on the stems of plants, near the embryo shoots, and these are hatched by the sun early in the spring. How beautiful is this care of the Creator for the meanest of his creatures! If the last autumnal brood of the *Aphides* was brought forth as the former, the frosts of winter would inevitably kill all, and exterminate the race; while the same sun which brings the eggs to maturity in spring, expands the young leaves upon which the parent insect intended her future progeny should feed: thus both leaves and insects come into life at the same time. But the most wonderful part of their history is the power of continued impregnation through a great many descents. A pregnant female, kept by itself, produces perfectly formed young ones, which, though kept separate, will, in a short time, produce others; and thus several generations follow each other. The male insects only appear in autumn; and this may explain why the last autumnal brood is enclosed in eggs. Réaumur computes that each *Aphis* may produce about 90 young; and that, in consequence, in five generations, the descendants from a single insect would amount to the astonishing number of 5,904,900,000. Were it not that these immense multitudes are called into being to furnish food for other races, they would be sufficient to destroy vegetation, and annihilate the empire of Flora. We accordingly find that, in "due season," they become the prey of many other animals, both in the bird and insect world. During most years, observes Mr. Curtis, the natural enemies of the *Aphides* are sufficient to keep them in check, and to prevent them from doing essential injury to plants. But seasons sometimes occur, when their increase is so prodigious that severe damage ensues, both to the crops of the husbandman, and to vegetation generally. Among the hop plantations, for instance, the *Aphides* are so prevalent, that the scarcity or abundance of the crop entirely depends upon their ordinary prevalence or unusual plenty; and hence the frequent reports on this subject in the newspapers. Vain would be the attempt to clear a hop garden of these pernicious insects, or to rescue any extensive crop from their baneful ravages. Even violent rain has but a partial effect in destroying them. Mr. Curtis immersed, in a glass of water, the footstalk of a leaf of considerable length, from a stove plant beset with *Aphides*. On immersion, they did not quit the stalk, but immediately their bodies assumed a kind of luminous appearance, from the minute bubbles of air which issued from them. After an immersion of sixteen hours, they were taken out and placed in the sunshine, when some of them almost immediately showed signs of life, and, upon an average, not one out of four was killed. So little effect, indeed, had this cold bath upon the rest, that one out of the survivors, a male, very soon after became winged, and another, a female, was delivered of a young one!

(135.) The *Thrips* of Linnæus are such exceedingly minute insects, that to the naked eye they seem but as little specks, or rather like short lines, not exceeding the length and thickness of the letter i. In spring, these minute creatures may be found running about the petals of flowers, particularly the dandelion; but in summer and autumn, they fly into houses, if not in swarms, at least in considerable numbers; they alight upon the hands and face, and occasion that troublesome irritation which many people experience during hot weather, without knowing the cause. Minute as these creatures are, Mr. Kirby considers them as highly noxious to the farmer, by deriving their nourishment from the embryo grains of the wheat plant.

(136.) In a scientific point of view, the *Thrips* is a still more interesting insect, since it unquestionably unites a suctorial order with another that is masticating. So naturally is this genus connected to the *Aphides*, the *Chermes*, and the *Cocci*, that neither M. Latreille, nor any of the subsequent reformers, have materially disturbed this arrangement; they include *Thrips* and *Aphis* in the same family, placing the *Cocci* immediately after. All entomologists admit that *Thrips* is a mandibulated type; although, from the excessive minuteness of the species, and the consequent difficulty of understanding with accuracy the parts of the mouth, we are somewhat deficient in figures and descriptive details. Sufficient evidence, however, is before us, to show that this genus connects the *Hemiptera*, which is a suctorial order, with some other which is both suctorial and mandibulated, or furnished with jaws. The question, therefore, which remains to be settled, is, to what mandibulated order this genus leads. Now, there is only one in the whole of the *Annulosa*, where the mouth, in the same manner, is provided both with jaws and a proboscis; and this order is the *Hymenoptera*. The very aspect of the figure of *Thrips* given by Réaumur, bears no slight resemblance to the genus *Scolia*; and that species figured by Mr. Westwood, no less reminds us of a hymenopterous insect. Great credit is due to Mr. Haliday, one of our best entomologists, for his valuable memoir on these insects; although we cannot entertain his idea of erecting them into an order. To his paper, and to Mr. Westwood's valuable figures and dissections*, we must refer the reader, — contenting ourselves with retaining the opinion of Latreille, that *Thrips* enters into the circle of the *Aphides*.

(137.) The *Aphides* present us with some of the most extraordinary analogies in nature. These singular creatures, as will appear by analogical comparison, represent, in their own circle, the hymenopterous order among the

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* Modern Classification of Insects, ii. 1. fig. 57.

Ptilota, the rasorial order among birds, and the ruminating tribe (*Ungulata*) among quadrupeds. Dissimilar as these groups are from each other in outward appearance, the reader will be nevertheless surprised when he learns how many things they possess in common. One of the chief peculiarities of the *Hymenoptera*, is their power of producing honey,— a faculty which is given to no other insects but to them and the *Aphides*: both are eminently gregarious — living in large societies or swarms; and in both do we find that one female is generally the parent of a whole community, which feed and live together. The wings of the *Aphides* are clear and transparent; and the structure of their nervures are more like those of hymenopterous insects, than of any other order; while the *Thrips*, as we have before intimated, bring these groups into immediate contact. Next compare the *Aphides* with the scansorial and rasorial birds; all these are typically gregarious, feeding only upon vegetables, and uncommonly prolific. The great developement of the tail is one of the chief characters of these birds; while the *Aphides* are almost the only *Cicades* which have caudal appendages. It generally happens, as a necessary consequence of remote comparison, that the more dissimilar are the objects compared, the fainter are their analogies: but sometimes this is not the case; and a remarkable exception to the rule is presented to us on the present occasion. Every one knows that it is from the ruminating animals alone that man derives that healthful and salubrious beverage which in the early ages of society formed his chief nourishment. No other vertebrate animal has been intended by nature to supply us with *milk*. Now, if we look to the annulose circle, and inquire whether Nature has bestowed upon any of these the same power of secreting a fluid destined to feed other creatures than its own young, the reply is in the affirmative: the *Aphides* exclusively possess this faculty. When Linnæus, therefore, with so much reason, termed these little creatures the *milch cows* of the ants, and when all subsequent naturalists have wondered at the beauty of the analogy, we may well be struck with admiration at finding this relation confirmed by those definite principles of the law of representation which we advocate. If the circular group which includes the *Aphides* be compared with all those which comprehend their prototype here mentioned, all these parallel relations will come out.

(138.). The *Coccides*, or plant bugs, succeed the last tribe: these are also of a very small size, and in their ordinary appearance resemble a scale; all the parts of the body being concealed underneath. They live on the bark and leaves of vegetables, whose juices they suck; and are great pests to our hothouse and greenhouse plants. The males have wings, and are much smaller than the females, which are apterous. The *Coccus Adonidum* Linn. is a familiar example of this family: its shape has been aptly compared to that of an *Oniscus*, or wood-louse: the whole insect is of a pale rose colour, and appears more or less covered with a fine white meal or powder: the male is very small, likewise rose-coloured, somewhat mealy, with semi-transparent milk-white wings, and four long filaments at the tail: the young are hatched under the husk or body of the parent, and afterwards disperse to feed separately. In regard to their technical characters, the *Cocci* have many peculiar to themselves. The female alone is furnished with a rostrum, or sucker, while the male has only two large membranaceous wings: this circumstance would seem to throw a suspicion on the propriety of placing these insects in an order where the number of wings are invariably four; more particularly, as Latreille remarks that the *Coccus Ulmi* has two poisers. But the whole characters, and more especially the innumerable analogies of these insects, show they are the most aberrant of *Hemiptera*, and therefore contain such insects as are most defective in the powers of flight, just as are the *Coleoptera* in the circle of the *Ptilota;* while their analogy to the *Cassidæ, Oniscus,* and other chelonian types, is remarkably beautiful. However destructive these insects may be to our fruit trees, they seldom attack such as are in a sound and healthy state. The *Coccus cacti*, or cochineal, has long been celebrated for the beautiful scarlet colour it imparts by dying, and which forms such an important article of commerce with the Western World. We may here advert to a common error, still prevalent among unscientific persons, who suppose that the cochineal dye is extracted from a berry.[*] This has originated from the appearance of the animal when dead: the female, in its full-grown pregnant or torpid state, swells to such a size, that the legs, antennæ, and proboscis become so small in respect to the rest of the animal, as hardly to be discovered, except by a good eye, or by the assistance of a glass; so that, on a general view, it bears a greater resemblance to a berry than to an insect. We may also advert to another error, viz. that the cochineal was a species of *Coccinella*, or ladybird. This seems to have taken its rise from specimens of the *Coccinella Cacti* being sometimes accidentally intermixed with the cochineal in gathering and drying.

(139.) The analogy which this group bears to the *Cassidæ*, the tortoises, and other oniseiform types, has already been brought before the reader; but, if he wish to have this resemblance placed in the strongest light, let him look to the figure of the *Coccus cataphractus* of Dr. Shaw [*], where he will see even the plates which compose the shell of the tortoise, actually defined in the most exact manner upon this pigmy representative of the chelonian reptiles. The whole animal, as Dr. Shaw observes, "being coated on the upper parts, in the most curious manner, in a complete suit of milk-white armour, as if cased in ivory." Again, in allusion to the resemblance which the *Coccides* have to a wood-louse, he remarks, that "their general appearance is very much that of an *Oniscus*, or millipede; the antennæ in both having a strong resemblance to a pair of forceps, being each curved inwards

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[*] Nat. Mis. vol. v

and pointed." Again, in reference to the *Coccus Adonidum*, he remarks, "It has the appearance of a small millepede, or *Oniscus*; being of an oval shape, and slightly convex above, with the body divided into many transverse segments, projecting sharply on the sides, and furnished with small processes or points." Now, these words, intended to describe a *Coccus*, are equally just when applied to an *Oniscus*; and, with very little variation, would be suited to the armadillos among quadrupeds, and to the larvæ of the Erycinian butterflies.

CHAP. IV.

THE HYMENOPTERA.

(140.) The order Hymenoptera, according to the series laid down in our last chapter, follows that of the *Hemiptera*. If a zoologist, versed in the other classes of animals, was called upon to select that character which he considered as the most essential, it would be, that these insects have an appendage to the tail, either in the form of a sting, or an oviduct. This character, in fact, is so general, that it only disappears in a portion of the order (*Tenthredo* Linn.) which is aberrant, and where we should naturally expect some one or more of the typical characters would be lost. It is by this, also, that the analogy of the *Hymenoptera* to the thysanuriform larva is produced; and both these, as will be clearly shown, are modifications of the ungulated type of quadrupeds. Other characters, not so universal as this, are exhibited in their wings and mouth. The first, where they exist, are membranaceous and transparent, furnished with corneous veins, arranged longitudinally and transversely, leaving large spaces,—a structure very different from that of the *Neuroptera:* the mouth is provided with horny mandibles and a lengthened rostrum, formed by the maxillæ; this encloses the tongue, which is used to lick up the food. The metamorphosis is variable, and shows how little can be depended upon this character when taken in a primary sense. The larva, in the great majority, is apod or vermiform; but in one of the aberrant groups it resembles that of the *Lepidoptera;* while the pupa is inactive in all. Such, concisely, are the main characters of the order before us. It is distributed over the whole of the world; and is, of all insects (excepting those which produce silk), that which, by the production of wax and honey, is exceedingly serviceable to man. When we add, that it comprises the bees, ants, and gall-flies, together with the wasps, and ichneumons, it will be apparent that the *Hymenoptera* are the most intelligent of all insects.

(141.) Looking to the characteristics discovered in all circular groups of the animal kingdom which have been minutely investigated, we shall take these for our guide; and thus, by synthesis, we presume the following to be the primary divisions of the class before us:— First, the *Apides*, or bees, which live almost entirely on vegetable substances: the body is short, thick, and hairy; the antennæ short and bent, and the legs comparatively short: they are nearly all nectivorous, and eminently social. The ants (*Formicidæ*) appear to be the most aberrant family of this tribe. 2. The *Sphecides*, or wasps, which live, either in the larva or perfect state, upon other insects, which are either killed and devoured, or wounded and stored up by the parent for the support of the young: the most typical (*Pepsis* Fab.) are solitary; only a few, like the European wasps (*Vespa*), build their nests in common. The body is lengthened, generally slender, and frequently petiolated; that is, as if placed on a slender stalk: the antennæ are slender and curved, but usually geniculated; and the legs are long, slender, and frequently serrated or spined externally. None of these insects collect the pollen of flowers, although many feed upon their nectar. The *Mutillidæ* appear to enter into this group, and to represent, rather than to associate with, the *Formicidæ*. 3. The *Ichneumonides*, or ichneumons, where the appendage to the tail, which has hitherto been a sting, now assumes the office of an ovipositor, being employed to deposit the eggs: the enormous developement of this organ in the typical group (*Pimpla*, Fab.) is very remarkable: this, with the parasitic habits of all these insects, their very slender filiform antennæ, and their linear bodies, which are frequently compressed, appear to separate them as a distinct tribe from our fourth division, the *Cynipsides*, including the *Chalcidites*, or gall flies. With few exceptions, these latter are very small, and even minute, insects, known at once by several remarkable peculiarities: their antennæ are almost always geniculated, and sometimes pectinated; the body and limbs are usually ornamented with brilliant metallic colours; and the hind legs, like those of the coleopterous genus *Haltica*, are sometimes thickened; and like them, according to Latreille, many have the power of leaping. They resemble the ichneumons in being parasitical in their larva state, and the ants by some genera being without wings. The fifth is the most isolated group of the whole; yet the *Tenthredines*, or saw flies, are so obviously allied to some of the typical *Hymenoptera*, that they cannot possibly be removed from this order, merely because their preparatory state or metamorphosis is different. The perfect insect is immediately known by the abdomen being sessile, or joined to the thorax throughout its whole thickness; it consequently has no separate motion, like that possessed by all the other tribes of this order. As it is not our purpose to enter into the internal arrangement of these groups, in reference to what may be the circular succession of their affinities, we shall at once proceed to their analogies, as being the chief basis upon which the foregoing arrangement of the tribes is founded.

Analogies of the HYMENOPTERA *to the* PTILOTA.

Tribes of the *Hymenoptera.*	*Analogies.*	Orders of the *Ptilota.*
APIDES.	Pre-eminently typical; proboscis or tongue very long; nectivorous.	LEPIDOPTERA.
SPHECIDES.	Sub-typical and raptorial; proboscis short.	HEMIPTERA.
ICHNEUMONIDES.	Caudal appendages highly developed.	HYMENOPTERA.
CYNIPSII	The most aberrant of their circles.	COLEOPTERA.
TENTHREDINES.	Head disproportionally large; body sessile.	NEUROPTERA.

We ground the correctness of the first two analogies upon the unquestionable facts, that the bees are the most typical, and that the *Sphecides* are the raptorial, tribes of the order. This arrangement coincides not merely with the corresponding tribes of the *Ptilota,* but with every tribe in the vertebrate and other circles contained in our preceding volumes. The superior length of the tongue in the typical bees and butterflies is well worth remarking, and is strongly contrasted with the universal shortness of this organ in the raptorial *Hemiptera* (*Reduvius* Fab.), and the equally raptorial wasps. The ichneumons, corresponding to the greater part of the *Pupivora* of Latreille, as representatives of the order in the entire circle, possesses one—and only one—of the typical characters in the highest state of developement,—a circumstance which we have frequently had occasion to point out is universal in all natural groups; and thus we consider the first three series of our table to be substantially natural. Respecting the fourth, in which we place the *Cynipsides* (including the *Chalcididæ*) as a tribe distinct from the ichneumons, we are not sufficiently clear. For a long time we were disposed to adopt Mr. MacLeay's opinion, that the ants (*Formicidæ*) constituted one of the primary types of the order; in which case they would have stood in the most aberrant position, as types of the *Coleoptera;* but their strong affinity to the more perfect and social *Hymenoptera*, and the impossibility of discovering the least relation between them and the *Tenthredines*, has induced us to doubt the correctness of this opinion, and to substitute, for the present, the *Cynipsides* including the *Chalcidites*. The singular prolongation of the scutellum in some of these insects, which Latreille very justly compares to *Scutellera*, gives them, at first sight, a closer resemblance to *Coleoptera* than any other insects of this order yet discovered: this, at least, we can say,—that two or three species found by us in Brazil have this aspect so strongly, that we mistook them, at first, for *Mordellæ*. The peculiarity also mentioned by Latreille, of most of the Fabrician *Chalcididæ* enjoying the faculty of leaping, is another point wherein they resemble the most aberrant tribe of the *Coleoptera*, no less than the *Syphonostoma*, or fleas, the acknowledged representatives of the beetles among apterous insects. Families, again, in which metallic colours run through the great majority of the species, are invariably the most aberrant in their own circles. We find this true in the humming birds, the tanagrine genus *Aglaïa*, the metallic pheasants of India, and the prismatic mouse of the same region. It is again seen in the *Chrysomelidæ* in the circle of the *Coleoptera*, in the *Buprestidæ*, in that of the *Lamellicornes*, and in the *Curculionidæ* among the *Capricornes*. However unprepared we may therefore be, to offer any opinion worth adopting on the rank of the *Chalcidites* and of the ants, we have not a doubt that both they and the genus *Chrysis*, together with the *Mutillidæ*, are all representatives of the *Coleoptera*, wherever their actual location in nature may be. As for the latter group,—the *Mutillidæ*,—we look upon them as more related to the true ants by analogy than by affinity: they agree only in being apterous,—a circumstance so common in widely different groups of this order, that it is by no means sufficient to constitute an affinity. The analogies of the saw flies (*Tenthredines*) to the aberrant *Neuroptera*, (or the *Phryganidæ*), although not so apparent, perhaps, in the perfect insects, are yet sufficiently strong to corroborate the idea of their being related to each other; for both have their larvæ eruciform. But in what manner, if any, the *Tenthredines* are connected to the more typical bees, must be determined by analysis. Characters founded upon any one single organ are generally artificial: yet it is very remarkable that, in the two typical groups of our arrangement of this order, the caudal appendage performs the office of a sting, while in the three aberrant divisions it assumes the functions of an ovipositor. Should our theory of the primary types be correct, no better characteristic of them can be given.

(142.) Preliminary to our special treatment of the habits, economy, distribution, and peculiarities of structure of the successive groups into which the *Hymenoptera* have thus resolved themselves, we propose making a few observations upon the order collectively. In the first place, we may remark that sexual discrepancies are as perplexing to the entomologist here, as in the other orders, and there is as frequently a difficulty in associating together the partners of a species: this is conspicuously the case among the bees. In the aculeated division of the *Hymenoptera*, there is, however, a tangible character whereby the sex of the individual may be discriminated; for the males have one joint more to the antennæ and the abdomen than the females. In the preceding orders of which we have treated, we have had occasion to observe the parasitical habits of many of the species, which occur more or less considerably throughout all insects. Here, however, although it is found very extensively amongst the *Diptera* also, it reaches its maximum; for one group, the *Ichneumonides*, as we here consider them, are almost exclusively parasites. The term will receive its explanation by our exhibiting the characteristic and discriminating features whereby it distinguishes itself in the several tribes in which it occurs. The *Ichneumonides*, or, as they were named by Latreille, *Pupivora*, from the peculiarity incidental to their mode of parasitism, deposit their eggs either upon or within the egg or larva of the insect upon which they are parasitical. The young, when disclosed, if deposited upon the surface, eats its way into the insect upon which it preys; but yet, guided by its instinct, it feeds so cautiously as not to interrupt the vital functions, and the creature progresses to the maturity of the pupa state, but, of course, in a sickly condition. Having undergone this change, its insidious enemy still lurking within it, its existence then draws to a close, for the parasite, becoming less restricted in its diet, consumes all before it; and having by that time acquired its full growth, it transforms either within the husk of the insect upon which it had preyed, or it pierces through this and spins its cocoon, and therein takes its metamorphosis upon the surface of this case. Sometimes a larva feeds but one of these parasites, when it consists of the larger normal *Ichneumones;* but myriads at other times inhabit it, when these are composed of *Chalcidites.* In these last instances, more than one species frequently prey at the same time upon the devoted victim, as we have repeatedly had occasion to observe, and much to our vexation; for, after having used every precaution to rear some rare lepidopterous larva, we have found all our assidous exertions thwarted by these tiny foes. It is not, however, the *Lepidoptera* alone that are subjected to these attacks, but some prey likewise on the *Coleoptera ;* and it is not improbable that all the orders may be infested by them, they having so little fellow feeling as to be destructive even to their own order. The second kind of parasites are those which occur in our group of *Sphecides :* these deposit their eggs within the nests of other *Spheces,* frequently of the same genus as themselves, for the purpose of being nurtured at the expense of the young, by consuming the food laid up in store by the provident parent; and, doubtlessly, these insects, being predatorial and carnivorous, feed upon the unhappy larva itself. An awkward collision must of course sometimes occur, where the developement of the parasitic larva is less rapid than that of its intended victim, and this, by acquiring early sufficient strength, neutralises the object of the parents, and turns "the tables" upon its progeny. A subdivision of this parasitical mode of breeding we observe among the bees, which more resemble that of the cuckoo than either of the other; and from this circumstance, those genera of bees wherein it occurs have been called cuckoo bees. Here it is merely the food that is laid up in store, that has been preyed upon by the larva of the parasite; for the bee not being at all carnivorous, the genuine inhabitant for whom the provision was made is starved by its abstraction by this intruder. In the bees that possess this habit, it is always an entire genus, and not a portion of a genus, as we have observed among the *Sphecides;* although the same object of resemblance is frequently obtained, by these parasitic bees belonging very generally, from structural character, to a cognate division of the group, as we shall have occasion to instance below. With regard to structure, we may here remark, that it occurs in a less fully developed state throughout this second division of parasites; but this is compensated by the superior instinct with which they are endowed, to enable them to evade the sagacity of the insects upon which they prey. Instances, however, of fearful retribution we shall record below, when we treat specially of the groups; and where we shall show that severe punishment has followed the heedless temerity of the parasite, when it has too rashly exposed itself to the indignation of the enraged parent. Although we have already observed that there are apparent deficiencies in the analogical structure of these latter parasites, we are not to note these as defects, but as a further exemplification of the universal economy exhibited every where in nature, which, fitting every thing to its end, is never lavish in superfluous, and consequently useless, implements.

(143.) In speaking here of the parasitic habits of the *Hymenoptera,* we may notice, that they are themselves exposed to the parasitical propensities of individuals belonging to other orders. This we here merely glance at, as we shall have further occasion to notice it; and it therefore remains for us to observe, in these general remarks, that we think it very probable that this order of the *Hymenoptera* will, eventually, when it shall have obtained all the attention from entomologists that it so well merits, prove numerically as extensive, or perhaps more extensive, than any other. In corroboration of the plausibility of this supposition, we have only to advert to the hosts of minute *Hymenoptera* discovered throughout the small area of our own country, and described by Messrs. Walker and Haliday; and when we reflect upon the prolific exuberance of more genial climates, exemplified in the multitudes of insects of the favourite orders of *Lepidoptera* and *Coleoptera* which the zeal of collectors have brought together, we may rationally expect that an assiduity equivalent to Mr. Darwin's would speedily advance the species of *Hymenoptera* to a triumphant competition in number with the most numerous of the recorded orders.

(144.) The *Apides*, or bees, compose our first large group. These insects are well known, from the universal reputation of the typical genus *Apis*, the domestic bee, which, from its social habits, has ever been esteemed emblematical of the monarchical government; whilst its steady industry, in storing up provision for the contingencies of a barren period, have been the admired theme of sages and moralists, who have constantly referred to it to rouse the inertness of indolence, and have cited it as an example of prudential foresight. These have thus given a name to a large group of insects, which, upon the progress of systematic entomology, were found to possess certain analogous peculiarities of structure. It must not, however, be inferred, because the bee most extensively known is social in its habits, and has been domesticated by man to contribute to his luxuries and comforts, that all bees participate in these instincts, and are equally fitted for a similar subjugation. This opinion would be erroneous, for it is among the social bees only that we find those thus serviceable; and, although a few other genera of bees are also social, we are not aware that any have been domesticated like our common hive bee, or its congeners, although the nests of the other social species are constantly plundered by the natives and inhabitants of the countries where they are found. The large majority of bees are, indeed, solitary in their habits, forming either cylindrical burrows in a variety of substances according to the species, or a cluster of small oval cells, placed usually within a cavity, either found or formed by the insect; and these cells are constructed sometimes of small particles of earth, or of a moulded clay.* They then deposit within them a store of food, consisting of a paste, formed by a mixture of pollen and honey, to serve as provision for the young. Having laid up this magazine, in the due proportions of which the mother insect is guided by an unerring instinct, she then deposits her egg upon it, and encloses an adequate space for the developement of her larva, and of its transformation. As we observed above, the several genera and species select different substances, wherein they nidificate; and they also follow different modes in the occupation of these burrows, for some line them with various substances, and others occupy them bare as they occur, but perfectly smooth within. Some, also, make them suit a succession of cells; and others deposit but one egg, and food but for one young one, in each; but we shall have further opportunity below to notice these different habitations, wherever they present any remarkable peculiarity of structure. These insects themselves are frequently very hairy, although many are completely smooth; and they are generally of sombre and uniform colours; but some are adorned with the gayest metallic and party-coloured vestments; yet it is chiefly among the parasitic tribes that a gaudy costume is conspicuous. The purpose which bees have to fulfil in the economy of nature, is to collect the superfluous pollen of flowers, and whilst collecting it, to convey it from plant to plant, whereby the impregnation of these is more securely effected than if it were left to the accidental agency of the wind; and, although this object is partially concealed beneath the instinctive propensity to collect nutriment for their young, yet is it so conspicuous, and has been so fully proved by the careful researches and observations of Sprengel and Kölreuter, that it must excite universal admiration at the comparatively simple, yet certain, means, Nature so frequently adopts to obtain important results,—one process accomplishing manifold purposes. To effect this end, they are of course furnished with adequate organs; and they are assisted to convey it, whilst collecting it from flower to flower, usually by means of a dense brush of hair, sometimes surrounding the posterior tibiæ and basal joint of the tarsus, but which is placed occasionally merely externally upon those members: in conjunction with this brush, there is frequently a long curled lock of hair at the base of the femur beneath; and where this occurs, the whole of that member is fringed, or the sides of the metathorax behind are very hairy. In others, the clothing of the legs is superseded by a very thick brush, occupying the under side of the abdomen; but, in the social genera, in lieu of the brush upon the posterior tibiæ, these, as well as the basal tarsal joint, are considerably dilated, and hollowed or flattened externally, and the margin fringed with hair, which thus forms a receptacle called a *corbiculum*, or basket, for the clodded masses of pollen and honey made into a paste by these social insects, or for the other stores of different materials that they may require in their domestic economy. Having thus briefly noticed these generalities, we will

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* An exotic genus, closely allied to *Osmia*, appears to form its cells of a rude kind of wax. This is a remarkable instance of any but a social bee using wax. We should not, however, thence infer, that, as in the other cases, it was a secretion of the insect, but possibly a vegetable production, or perhaps the result of plunder from one of the social kinds.

[illegible] we now proceed to the investigation of the economy of this group of insects.

(145.) It has been found convenient by systematists to subdivide the bees into two large groups, which are determined by the mode in which the tongue or proboscis is folded in repose, and the comparative length of that organ. Of course, it was to be expected that a lengthy organ, as this usually is, must be folded to enable it to be brought within the protection of the horny parts of the mouth. Thus, in the *Andrenidæ*, which constitute the first large division, we find the proboscis folding only at its base; and this, from the comparative shortness of the organ, draws it sufficiently within its protecting cases; or at most the extreme apex (the *lingua*) is recurved, and thus the large angle is placed behind, the tongue lying in front of it and forwards. In the *Apidæ*, however, we find a double flexure, there being still a small basal bend; but another larger one occurs in front, at the insertion of the maxillary palpi; and this throws the tongue backwards beneath, and whither the apical half of the maxillæ follow it, and cover it with their horny protection. The distribution into genera, of the insects composing these two divisions, has been effected by studying the comparative proportions of the proboscis, and the varying numbers and forms of the articulations of the palpi, taken either independently, or in conjunction with other peculiarities of structure, such as the form of the legs and tarsi, their clothing, the clothing of the venter, and neuration of the wings; and the correctness of this mode of investigation is corroborated by its always associating insects nearly identical in form and habits. To the Rev. Mr. Kirby we are indebted for this invaluable arrangement, and the work wherein it is recorded, the *Monographia Apum Angliæ*, will remain the noblest monument of his entomological immortality. It is much to be regretted, that certain fastidious views with respect to nomenclature interfered with his giving names to the sections into which he broke up this large concourse of insects; for, by omitting to do it, it has unfortunately happened that names have been applied to them by Illiger, Latreille, and other continental authors, whereby our countryman has partly been deprived of the well-earned universal record of his labours. We must not, however, complain of the candour of these authors, for they have done ample justice to the originality and merits of Mr. Kirby's treatise, which we cannot too strongly recommend to the diligent and careful study of young entomologists. They will find that it will teach them to digest thoroughly their plans; and it will enlarge their views beyond the feverish expectancy of a precocious and questionable celebrity, so easily and unworthily attainable, by the establishment of insulated remarkable genera; for it is only by taking up groups, and thoroughly discussing them, that the progress of the science can be at all promoted.

(146.) We find that it is by *Colletes* in the ANDRENIDÆ that the bees are most intimately connected with the *Spheces* and wasps; its bilobated tongue exhibits the point of contact with some of the extreme genera of fossorial aculeates. This genus is also remarkable from its mode of nidification, and the silken cells it forms; and by its possessing two parasites,—one the beautifully variegated *Epeolus*, a cuckoo bee, and the other the dipterous genus *Miltogramma*. The peculiarities of the other genera of the *Andrenidæ* are, the wood burrowing parasitic *Hylæus*, which, when caught, emits a delightful and powerful fragrance of lemons; and *Sphecodes*: the insects upon which these are parasitical, the most careful research has not yet discovered. We next have the extensive genus *Halictus*, which is peculiar for the caudal vertical incision in the females, and the cylindrical body and length of antennæ in the males. We here find another exemplification of the divergence of extensive genera from their types; for we observe forms in this genus which seem to point in a variety of directions. Although the genus occurs throughout the world, it is found most extensively in

America and Europe; but it is in the former that its most eccentric species occur. The approximate genus *Nomia*, which is also found throughout the world, appears to represent *Halictus* in India, where possibly it is of similar extent, if we may judge analogically from the diversities of form that occur in the species we have seen. This genus is distinguished by the usually very enormously enlarged and curiously spined posterior femora and tibiæ, and elongated tarsi of the males, and the frequently very large tegulæ of both sexes. A remarkable species of this genus we are acquainted with from the Cape, which has the anterior tarsi dilated like the first section of *Megachile*. In this division we will only further allude to the extremely elegant *Dasypoda*, which derives its name from its densely hairy posterior tibiæ and tarsi, and which are furnished with an increased facility for retaining the large masses of pollen they enable the insect to convey, by each hair giving off on each side, throughout its whole length, other innumerable very short and slender hairs.* The remarkable genus *Macropis* Klug (the *Megilla labiata* of Fabricius) has recently been added to the British fauna; and we owe the possession of this unique insect to the liberality of the captor, Mr. Walton, who took it in the New Forest; but we introduce the notice of it here, only to observe that it distinctly points in many peculiarities to the fourth division of the solitary bees (the *Scopulipedes*). The typical genus *Andrena* is perhaps of still greater extent than *Halictus*; but its range, both structural and geographical, is more confined, indeed, it rarely presents abnormal species. It was upon one of this genus (*A. nigroænea*) that Mr. Kirby made the interesting discovery of the very singular parasite *Stylops*, the peculiarities of the natural history of which we shall give in its proper place; and it is also upon *Andrena* that the little hexapod creatures occur, called, we think very correctly, *Pediculi* by Mr. Kirby, but which have been asserted to be the larvæ of *Meloë*: the correctness of this opinion we dispute; but shall leave the notice of our reasons for doing so until we arrive at the *Coleoptera*. We are further acquainted with many undescribed exotic forms among the *Andrenidæ*, some of which are highly interesting.

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* Various kinds of this peculiar structure occur in different genera, and none of which have before been noticed: it has also modifications which accomplish the same purpose; thus, in *Panurgus*, instead of the hairs being pilose, they are crenulated towards their extremity. That it only accompanies certain peculiarities of economy is proved by many of the very hairy-legged divisions of the bees (the *Scopulipedes*) having these hairs entirely simple. I am preparing a paper on the subject, in which all these peculiarities will be shown.— W. E. Sh.

(147.) We now enter the division of the Apidæ, or genuine bees, where the diversities of form and structure are greater than in the preceding division, and which consequently has given rise to a more extensive subdivision into genera. It is, however, very probable, judging from the contents of the collections which we possess and have seen, that the species are not numerically greater than in the *Andrenidæ*. The *Apidæ* resolve themselves very naturally into two subdivisions, the solitary bees and social bees. The first of these subdivisions, the solitary bees, may be conveniently grouped according to very obvious structural peculiarities, and which, as usual, concur with the habits of the insects.

(148.) We have, Firstly, the Andrenoïdes, or those approaching, both in structure and habits, to the *Andrenidæ*. These make their burrows in a similar way to the typical portion of that group, and have their posterior tarsi formed upon the same structural model: they also, like those insects, generally frequent syngenesious plants. The most remarkable genera are *Rophites*, which has the apex of the abdomen in the male denticulated beneath; and *Systropha*, which in that sex has the extremity of the antennæ very singularly curved. The general structure of *Nomada* includes it better within this group than with the other cuckoo bees, with which, from habits, it might otherwise be associated. These gay and wasplike insects are parasitical upon various species of *Andrena* and *Halictus*, but one infests *Eucera*.

(149.) The second subdivision of the solitary bees, the *Dasygastræ*, are thus named from the hirsute clothing of their venter, by which they carry their provisions, and never by their legs, which is the case in all other bees. They constitute a large group, some of the genera of which are very extensive in species, and many of these have received vernacular names. Thus, we have the LEAF-CUTTER BEES, *Megachile*, for instance, a very numerous genus, extending all over the known world, and tolerably equally distributed. The males of some of the species have the anterior tarsi considerably dilated. It is upon these insects that the coleopterous genus *Clerus* is probably parasitical. They derive their name from the habit many of them possess of cutting semicircular pieces of leaves from different plants, and with which they line their burrows, usually formed in soft and decaying wood, whence they have sometimes been called carpenter bees, which is perhaps better restricted to *Xylocopa*. It is upon the cognate genus *Chelostoma* that Mr. Marsham observed the *Ichneumon*, *Pimpla Manifestator*, which has so largely a developed ovipositor, to be parasitical. In this group there is no genus, excepting only *Lithurgus*, which does not occur in Great Britain.

(150.) We have next the MASON BEES, *Osmiæ*, the majority of this group form their nests in the third mode we have described above; and *Anthidium*, insects gaily marked with yellow bands and spots. In this genus the males are greatly larger than the females, and under the impulse of passion convey her off into the upper air. This genus is further remarkable for the habit it has of lining its nests with the downy coating of plants. It does not, in this country, make its appearance much before the summer solstice.

(151.) Upon these follow the CUCKOO BEES, which are all parasites; but although it is convenient to group together a certain number of these on structural accounts, yet shall we find some genera of parasitic bees straggling into the following subdivisions that we have to notice. Here we have *Melecta*, that infests the gregarious *Anthophoræ* and *Eucera*; the very gay *Crocisa*, distinguished for its beautiful white and cærulean markings; the pretty little *Ammobates*, *Philerenus*, and *Epeolus*, parasitical upon *Colletes*, and *Cœlioxys* whose young is reared at the expense of that of *Megachile*. We further observe the exotic resplendently metallic *Aglaë*, *Mesonychia*, and *Mesocheira*; *Ischnocera*, with its exceedingly attenuated and nodose antennæ in the males. The three last of these are conspicuous for the structure of the calcar of the intermediate legs, which are furcated towards the apex, and one of the branches multidentate, resembling an expanded hand with its thumb and fingers. It is very probable, also, that the beautiful and large genus *Acanthopus* belongs to this group, for the female is not known, and has a similarly constructed intermediate spur: the furcation of this organ probably supersedes the possession of the usual pair. With the exception of *Melecta* and *Crocisa*, which are cosmopolitans, we have detected these parasitic genera to be natives only of Europe and America; and the richly metallic species being, as far as we are yet acquainted with them, restricted to Tropical America and the West Indian islands.

(152.) The last large subdivision of the solitary bees, the *Scopulipedes*, or Hairy-Legs, collectively present the most assiduous collectors of pollen among the bees: the posterior tibia and basal joint of the tarsus are densely hirsute in all; and in many it is difficult to detect the form of the limb for the hair: the thickened and distorted structure of the legs of the males of many of them is very remarkable. The habits of a few only are known, the majority being exotic; and the collectors of exotic insects have rarely cared to notice or record the habits of their captures. Our native genera consist of *Eucera*, named from the length of the antennæ of its male; *Saropoda*, and the gregarious *Anthophora*, the tones of the hum of the different species of which are so peculiar and distinctive. Here also should be placed the small Southern African genus *Allodapa*; and our pretty little *Ceratina* may be inserted contiguous to the continental and exotic *Xylocopa*. The latter constitute a very numerous genus, for we are acquainted with more than a hundred species, and they are the largest and most bulky of all known bees; the female of the oriental *X. latipes* being more than an inch in length, and two inches in expansion. These are most truly carpenter bees; and as they occur numerously in countries fertile in timber, and of an exuberant vegetation, one purpose of their economy may be to hasten its decomposition when dead, by exposing it to the internal access of wet and fungi, by the large lengthy longitudinal perforations they make to deposit their young in security. They are subjected in the West Indies to the parasitical attacks of the coleopterous genus *Horius*; and probably, in other countries, other parasites prey on them. This genus presents some difficulties in its study, arising from the uniform intensely black colour of the greatest number of the species: their wings, which are of a brilliantly metallic steely blue or coppery colour, have been referred to as affording safe specific diagnostics; but we think incorrectly, for they are liable to all the contingencies of age and use: the sculpture of the clypeus we consider presents a safer clue. In the great majority of this genus, nothing but direct observation can bring together the genuine partners of the same species, as in very many instances the males are yellow or fulvous, and the females black or metallic. Here, as in *Nomia* and *Halictus*, we observe the species diverging in structure from the type. In some males we detect a dilatation of the anterior tarsi, as in *Megachile*; but these appear linked to the more normal form by means of the fulvous species, which have the anterior tarsi densely ciliated. Another divergent form from Western Africa, which has the intermediate legs very long and spined, and with curled locks of hair, has been raised, unduly we think, to the rank of a genus, by the name of *Mesotrichia*, and has been considered as linking *Xylocopa* to *Anthophora*, by means of those species of the latter which also have males with elongated intermediate legs: these are, however, also, abnormal species, and ought not to be considered typical. This subdivision contains very many more genera, such as *Epicharis, Centris, Oxæa*, &c.; the mere names of which, as they convey neither information nor amusement, we will pass over: we may, however, state that it is in this subdivision that bees with the longest and most highly organised tongues are found.

(153.) The last division of the bees, the social tribe, are doubtlessly the most interesting of all, from their habits, economy, and uses. Our space will not admit of our going particularly into these circumstances; and it is the less necessary, as there is no treatise on Entomology but what abounds with details upon them; and we shall therefore only speak of those particulars that have been hitherto least noticed. The genera of these insects consist of *Bombus* Linn., and its parasite *Psithyrus* St. Farg., *Euglossa* Fab., and the identical *Cnemidium* Pty., and *Eulaima* St. Farg., with their parasite *Chrysantheda* Pty.: *Mellipona* and *Trigona* of Latreille, and lastly *Apis* itself. The species of the genus *Bombus* form or seek cavities in the ground, which some line with a warm coating of moss interwoven together, and within which they build a series of irregularly clustered oval cells constructed of a very coarse kind of wax: others do not form this mossy lining, but instinctively seek a very sheltered situation. *Bombus* appears to be a northern and chiefly European and American genus: there are very few intertropical species; and we only know two oriental. The genus *Psithyrus* so closely resembles the insects upon which they are parasitical, that they readily escape detection, and are not uncommonly confounded with them by naturalists. It is still uncertain if *Euglossa* is social, and if their communities consist of three kinds of individuals. This has been assumed, upon the analogous structure of their posterior legs, which much resemble those of *Mellipona* and *Trigona*: the majority of the species are splendidly metallic; and we think both *Cnemidium* and *Eulaima* too closely like them to admit of generic subdivision. *Chrysantheda*, we have not the least doubt, is parasitical upon the metallic *Euglossæ*. These insects belong exclusively to the western hemisphere, and it has been stated that such is the case also with *Mellipona* and *Trigona*; but we are acquainted with species of the latter, which were brought from Java by Dr. Horsfield, and from Sumatra by sir Stamford Raffles, and St. Fargeau has also described one from Timor. From the vicinity of the latter island to New Holland, it is, therefore, not improbable that this genus may be discovered there; for we have yet seen no genuine bee from that country, excepting such as have been imported by colonists, nor do we know any insect that does there represent it. These insects, *Mellipona* and *Trigona*, are likewise frequently found in gum anime and copal. The occurrence of bees without stings is an anomaly that we are scarcely prepared to expect, especially where there are such rich stores to defend as these insects form; and yet this is reputed to be the case with the indigenous social and honey-making bees of America. Those of the genus *Apis* which are found there were originally introduced by colonists; but they have now permanently naturalised themselves, and occur at large in the woods. Much obscurity still hangs over the natural history of *Mellipona* and *Trigona*, and we are yet insufficiently acquainted with their sexes. The marquis Spinola has recently helped to clear away some of the difficulties involving these insects, and has shown that we are scarcely to expect here those great sexual discrepancies that we meet with in the genuine *Apis*. These insects are usually very small; and all that we know of their natural history is, that their nests consist of large assemblies of individuals, which form their waxen hives within hollow trees or the cavities of rocks. They make large quantities of wax, and are not, apparently, so economical in its use as *Apis*; for, from the figure given of a portion of one of their nests by Huber, in the *Transactions of the Society of Natural History of Ge-*

neva, it appears more carelessly and less ingeniously formed, although the hexagonal structure of the cells still predominates in it. Some, it is said, form nests of irregularly attached oval cells, like our *Bombi*. It is quite impossible to think of giving here, where we are so cramped for space, any thing like a suitable account of the economy of the hive bee (*Apis domestica*) and its congeners; but as this is dwelt upon in every book treating upon insects, we shall merely mention the extent of its distribution. Thirteen have hitherto been described, and others we know: two species only seem to occur in Europe,—one confined to the North (our domestic bee), and the other to the South. Others, we surmise, might possibly be found in Spain, from its proximity to Africa were that fine country diligently searched. Western Africa and India appear to produce the greatest number of species; but we believe they are not as diligently cultivated in those countries as in Europe and Egypt, although this might be supposed to be the case in Western Africa, from the large quantities of wax that are imported thence, and which are brought from the interior. It would be trite to remark upon the uses of these industrious little insects to man, prior to the discovery of the sugar-cane. They must also have abounded in Judea—that land flowing with milk and honey; and the allusions of the oriental poets show the extent of their appropriation throughout the east. The enormous consumption of wax in catholic countries, both now, and when Europe was wholly catholic, and before it could be substituted by a vegetable extract, and the produce of a whale, exhibits the little insect in another *light*,—that of contributing to the religious rites of man; and this further shows what extensive employment they must have afforded to multitudes of individuals: but we will close the subject with expressing our gratitude for its adaptation to the wants and the comforts of man, and our great admiration of the wonders of its economy and instincts. We have dwelt purposely longer upon this group of insects, from the universal interest that attaches to them, than we shall be able to do with the other groups of the *Hymenoptera*, or than otherwise our prescribed and limited space would have authorised.

(154.) The FORMICIDÆ, or ants, are the next large group of which we shall treat; but the connection between them and the bees is any thing but apparent, as they seem allied only by their social habits. These habits present us with very many interesting peculiarities, which, however, have been studied only in a few European species. To judge from the eccentricities of form presented by the majority of exotic species, we may rationally conclude that their diversities of structure run parallel with differences in their economy and manners. Wherever Nature presents a peculiarity of workmanship, it is not a merely futile display of power, but it has a direct tendency to a specific purpose, which, although not always obvious, is necessarily to be inferred from the unvarying evidence we already possess wherever we can trace it to its object. All the species of this group comprise three individuals; or sometimes four, if the fourth, where it occurs, may be considered otherwise than as a modification of the third. These consist of males, females, and neuters, or workers; to which, in some species, another class—that of *soldiers*—appears to be added. Whether these neuters, as in the social bees, are to be considered as abortive females; and whether the ants possess the means, like the bees, of supplying any accidental contingency in the nest, by developing the sexual inertness of these neuters, through any particular course of nurture, has not yet been ascertained. There seems to be no uniformity, even amongst congeners, in their habits or architecture, for we observe species of the same genus following different modes of life. As amongst the social bees, some possess stings, and some are without these formidable weapons, which are, however, supplied by a very powerful acid secreted by them, and ejected in defence, and which is doubtlessly quite as effectual in protecting them from their natural enemies.

It is within the tropics that these insects chiefly abound, and where they are excessively destructive; and nothing seems efficiently protective against their incursions. The group has been divided according to the structure of the abdomen; which in some has but one node only to its peduncle, but in others it has two. It is in the first division that we find the stingless genera, namely, *Formica* Linn., *Formicina* Shkd., *Polyergus* Latr., *Polyrhachis* Shkd., and *Dolichoderus* Lund, besides several other yet uncharacterised genera, which we shall shortly publish.

(155.) The *Formicina rufa*, or horse ant, forms those large nests of dry leaves and sticks we so frequently observe in the woods; and within these nests two genera of *Staphylini* appear to be parasitical—*Lomechusa* and *Pella*; and in their deepest recesses innumerable woodlice (*Onisci*) are constantly found. The nature of the connection between these insects has not yet been ascertained, but perhaps it may be analogous to what has been observed between other species and the *Aphides*. It has been said that the larva of *Cistela lepturoïdes* also lives in the nest of this species. Another singular *Staphylinus* (the minute *Claviger*), which is totally blind, and otherwise remarkable in structure, inhabits the nests of the *Formicina flava*, where it has once been discovered in this country. Some of the species and genera of this tribe, it is said, exclusively of the *Formicidæ*, seek in the nests of other species, but always of the same tribe, the auxiliaries, upon which they impose all the "out-door" labours of the community; but it is the genus *Polyergus* which is most distinguished for its subjugation of "helots," or "slaves." *Cercopis* and *Membracis*, two genera of *Hemiptera*, supply the place of the "Cow Aphis" to the Brazilian genus *Dolichoderus*. All the *Formicidæ* are extremely pugnacious, and fight with inveterate obstinacy; and frequently issue from their nests in close columns, for the purpose of attacking neighbouring colonies; this, of course, with variable success, but great slaughter is always made. *Odontomachus* constitutes the transition from the stingless to the aculeated division of the *Formicidæ*. These insects construct their nests in hollow trees, and are exclusively found in the New World and its islands; but we are acquainted with a yet uncharacterised genus from Ceylon, which closely links the latter with the next genus, *Ponera*. The latter is of universal distribution, but exceedingly variable in form; it at present evidently incorporates many other very distinct genera, which we propose separating from it. By the strangulation of the second segment of its abdomen, it makes a very convenient passage to the next division of the group,—those with two nodes to that portion of the body. We are unacquainted with its habits; but in the absence of any account of extensive building or mining, which could scarcely have escaped observation, from the multitude of species that have been collected, we surmise that its powerful mandibles indicate very destructive propensities. The communities of the European species (which also occurs in this country), *P. contracta*, are said to be small, and to live under stones; and, indeed, the neuters only, of one sub-genus in particular, the *Ponera gigantea*, have come under our notice; which, from its conspicuous size, would certainly have attracted attention, had they formed large dwellings, or associated in numerous bodies. In the division with two nodes to the peduncle, we have some doubt if *Condylodon* Lund, be truly an ant, for its form greatly resembles some of the *Mutillidæ*. Lund, during the whole of his residence in the Brazils, observed only a single specimen of the genus. We are, however, acquainted with nine species, all apterous, and all of which seem very rare; and this circumstance, even if they be social, would of course imply that their societies were small. *Myrmecia*, of which the type is the *F. gulosa* Fab., is exclusively confined to New Holland and its adjacent islands; it appears to be very numerous in distinct species, which differ considerably in size,—even more so than we usually observe in natural genera, which generally present a tolerable uniformity. *Eciton* is exclusively American; and its type, the *F. hamata*, presents us with the most singular structure of the mandibles observable in the *Formicidæ:* these organs, which are slender, are protruded in a curve to a great length, and are at their apex recurved upon each other. We think it probable that this form is merely a modification of the neuter of the *Formica curvidentata;* for, with the exception of the mandibles, both have an identity of organisation, and exhibit the smallest eyes of any of the group. We may, indeed, here observe generally, that the eyes of the *Formicidæ* present greater differences of size and position than we detect in any other natural group of insects, and in several they are totally wanting. *Eciton* appears also numerous in species, and neuters only do we know, but these are evidently genuine ants. The universally distributed *Crematogaster* displays a singularly recurved and heart-shaped abdomen, which has its peduncle inserted from above. *Myrmica,* and a few small cognate forms, are the only ones of this division that occur in Great Britain. The *Attidæ,* which offer such an enormously developed head in the modification of the neuter individuals, takes a more southern range; and the genus *Œcodoma,* the type of which is the *Form. cephalotes,* appears to be tropical and American; but we know allied forms from the east, which, perhaps, possess equally destructive propensities, and constitute as numerous communities. We must, however, hasten on; for a volume bulkier than the present would scarcely do justice to all the peculiarities of habits and organisation that we meet with in the *Formicidæ;* but we cannot quit them without noticing the spider-like form of *Cryptocerus;* and, indeed, Lund informs us that its habits and movements as much resemble those of a spider as does its form. It is comparatively solitary, although consisting of three individuals; and is usually found upon or beneath leaves, lurking, curled up, ready to spring upon its unwary prey. It derives its name from the structure of the head, which has, on each side, a deep lateral channel; wherein, in repose, the antennæ are inserted and concealed. The male has not yet been noticed, and perhaps not before known, as it differs in this particular from its female. The genus has hitherto been considered wholly American; but we possess a species from New Holland, and we are acquainted with a closely allied genus from the east. It appears to us, from a careful review of an extensive collection of the *Formicidæ*, that the genera hitherto established, with a few exceptions only, constitute the types of as many natural families. Contiguous to the *Formicidæ* we observe the *Dorylidæ*, a small and very natural group of insects, one sex only (the males) of which, throughout its four very distinct and marked forms, have yet come to Europe; and this is the more striking, as the genera consist of several species. We have hazarded the hypothesis *, founded upon analogous peculiarities of structure both with these and the contiguous groups, that certain blind and apterous insects, ant-like in their appearance, from Africa and the West Indies (*Anomma* Shkd. and *Typhlopone* West.), may possibly be the females of some; but this is merely conjecture. Two forms of this group, *Dorylus* and *Rhogmus*, occur in Africa; the former, however, extend to India. The latter continent exhibits another form peculiar to itself (*Œnictus* Shkd.), which links, by participating in the structure of both, *Dorylus* with that form of the group (*Labidus*) found exclusively in America and its dependencies. These insects are further remarkable from the sexual organ of the male exhibiting specific differences.

(156.) It is perhaps convenient from this point to enter the *Sphecides*, through the medium of the *Mutillidæ*. Although we here observe apterous individuals, we think the circumstance scarcely a link of affinity with the *Formicidæ*; for, in the *Mutillidæ*, it is the prolific female which is apterous, which is never the case in the former; and we have already hazarded a doubt if the neuters be positively *abortive females*. In-

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* See Shuckard's "Monograph of the Dorylidæ," June, 1840.

deed, the occurrence of apterous genera is a circumstance far from uncommon in all large groups of insects; and it perhaps merits consideration whether, naturally, Latreille's solitary *Heterogyna* do not disperse themselves throughout the aculeated *Fossores*, instead of being collected together; which is, possibly, merely a systematic convenience, although it is in some measure confirmed by the structure of the prothorax of the males. The numerous typical genus *Mutilla* offers a repeated instance of what we had occasion to observe in the genus *Halictus*; the divergence, namely, of extensive genera from their types. We are acquainted with nearly 200 species of this genus; and it is, perhaps, the most numerous, excepting only *Ichneumon*, throughout the *Hymenoptera*. The occurrence of pectinated antennæ is extremely rare amongst the fossorial aculeates; we have seen it only in *Psammotherma*, belonging to this group, but it is said to be found also in one of the *Pompilidæ*, among the typical *Spheces*. *Apterogyna* is remarkable for the constriction of the basal segments of the abdomen in both sexes, and also for the evanescence of the apical nervures of the wings. *Thynnus* and its numerous cognate genera enter here, for its females are all apterous. Many species, and the legitimate partners of several of them, are now known to us: the latter, however, could only be ascertained in consequence of the differences of their colour, sculpture, and form from the males, from the direct observation of friends in New Holland, where, with the exception of two or three genera, the whole of the family which they necessarily constitute are found. It is into this family doubtlessly that the *Elis* of Fabricius (*Myzine* partly of Latr.) enters; for they cannot longer be associated with *Myzine* (*Plesia* Jurine), as we know the males of the latter. The females of the *Thynnidæ*, especially those of the more typical genera, present many remarkable structural characters, in the form of their legs, and of the terminal segment of the abdomen; and in some there are singular longitudinal and transverse deep sulections of the head and face, which give it a cruciated appearance. The males vary considerably, from a short ovate form, similar to *Bembex*, to a long and cylindrical shape. *Elis*, only, is found in Europe; the others that are not Australian occur in America.

(157.) We now enter the normal group of SPHECES, which are all winged insects. The point of contact seems naturally to be the *Scoliadæ*. With the exception of the few parasites that occur in it, these insects are all predacious; but this term, as regards them, must receive explanation, as it would imply that they themselves prey upon and devour other insects. This is not the case; at least, no instance of it is yet known to us; and it is better thus to modify the assertion; for we constantly and hourly detect that Nature, in her discursive progress, will not be tied to the rules we lay down from the observation of a few facts. From what has been observed, it appears that these insects seek their prey merely to provision their cells with nutriment for their young; and they themselves, for their food, visit flowers only. In the perfect state, they seem to require but little nourishment; for, excepting a few genera, they are rarely found upon flowers; and this is the more remarkable, as their mouths are of a very highly organised structure. Parasites, amongst them, have not yet been proved, and have been assumed from the circumstance of certain species being divested of the prevailing characteristic of the fossorial tribes, which consists in a long external fringe of setæ to the anterior tarsi, generally coincident with posterior tibiæ armed externally either with a longitudinal serration or succession of spines. That this is not invariably the case in the predacious tribes among them, we have already fully shown*, from direct observation. Nor is it the diagnostic exclusively of those which burrow in wood, which we once thought might be the case; and the theory appeared plausible, as it of course could only be those which burrow in sand, and similar concrete substances, that would require such a brush-like implement. But we subsequently found, that even some truly predaceous sand burrowers (for we caught them with their prey) were unfurnished with this structure. This circumstance strongly proves how unsafe it is to theorise too hastily upon a few facts only. The wood burrowers, however, seem to possess a less variable peculiarity, which is in intimate connection with their economy and habits. They are generally lengthy insects, and have short legs; but their distinguishing feature is to have either very large and strong mandibles, dilating towards their extremity; or where these are smaller, not dilated, and parallel, they are then shorter and more compact, and the head is then considerably enlarged, to give room for the exercise of powerful muscles. We thus see how provident Nature is of her creatures; she endows them with peculiar instincts, and, for the exercise of those instincts, furnishes them with the requisite instruments. A lengthened body and short legs is not confined to the wood burrowers, for we find it conspicuous in the *Scoliadæ*, *Cratronidæ*, and *Philanthidæ*. The characters upon which these insects have been collected into families are not sufficiently precise; and very many forms, we have not the least doubt, still remain to be discovered. The *Scoliadæ* and *Pompilidæ* are the only families among them which present a thorax constructed similarly to that observed in the male *Mutillidæ*, and which is more or less developed according to the genera, and extends backwards as far as the insertion of the superior wings. We perceive a modification of this structure in the *Ampulicidæ*, which forms the transition to the collar of the rest of this group. Their eyes are usually lateral and ovate; but in some they are kidney-shaped, which indicates a departure to that normal form found in the *Vespidæ*. In the *Scoliadæ*, *Scolia* itself exhibits to us the most bulky insects in the group. This genus is of universal distri-

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* See Shuckard's Essay on the Fossorial Hymenoptera, *passim*.

bution. *Meria* appears confined to Southern Europe and Africa; whereas *Mysine* (*Plesia* Jurine) is found every where excepting in Europe; and this circumstance corroborates the assumption that *Elis* Fab. (*Mysine* partly Latr.), cannot possibly be the males; were not this independently proved by our possession of two genuine males of the genus, which, in form, closely resemble the females, have not the ventral segments constricted, nor the anal segment spined; and they confirm the situation of the genus in this family by the slight sexual differences observable in the neuration of the wings which occur throughout it. *Epomediopteron*, of which we are acquainted with three species, is limited to the New World, but *Tiphia* occurs every where except in New Holland.

(158.) In the family of the *Pompilidæ*, *Pompilus* is of universal occurrence, an extensive genus, and of divergent structure within itself. *Pepsis* embraces the giants of the group, and, as yet constituted, is found both in the Old and New World; but a small, although evidently important, distinction separates them into two divisions. Thus, in those of the New World, and to which we would retain the name of *Pepsis*, the first recurrent nervure is inserted at the basal end of the second submarginal cell; whereas in those of the rest of the world, to which we have given the name of *Mygnimia*, this recurrent nervure extends to the apex of that cell. All these insects display great brilliancy in the colouring of their wings; and, in a collection of them, rich blue, deep violet, purple, green, fiery red, and black, with a limpid apex, vie with each other in beauty and variety; and these are again contrasted with party colours, and wings elegantly spotted with silvery white. The size and strength of these insects are adapted for competition with the ferocity or size of their prey, which consists either of the large intertropical spiders, or of the monstrous caterpillars of the larger *Lepidoptera*. Other interesting forms occur in the family, such as *Salius*, with its largely developed prothorax; *Planiceps*, with its flattened head and raptorial anterior legs, as well as produced prothorax; *Megascelis*, with its large coxæ, and intermediate thighs; and *Exeira* Shkd., wherein the form of the prothorax passes off into the usual transverse collar. In this last genus, which is from New Holland, we observe the only instance of a petiolated submarginal cell; a structure found in every one of the families of the fossorial aculeates, but which was not known in this until the description of this insect. It is strange that the *Ampulicidæ* should have been allowed to remain so long incorporated in the midst of the family *Sphegidæ*, presenting, as they do, so many distinctive characters. In the first place, the heteroclite structure of the abdomen, which not only distinguishes them from the rest, but is also sexual; for in the male it is exceedingly obtuse and rounded, and in the female very acute, and either compressed or conical at its apex; and the second segment of which is the most largely developed, in some genera occupying nearly the whole of the abdomen, and in all with which we are yet acquainted, the segments, after the third, are very small. The majority of these genera also exhibit a remarkably sculptured metathorax, armed at its extremity with a couple of spines; their clypeus is produced generally into a sort of aquiline nose; but the most remarkable circumstance in their structure is the pulvillus of the under side of the penultimate joint of the tarsus,—an organisation observable no where else among the aculeated *Hymenoptera*, excepting in some of the social *Vespidæ*. They are said to prey upon the *Blattæ*, and some one genus of them is found in all quarters of the world: the majority are brilliantly metallic, either blue or green, which is agreeably contrasted, occasionally, with red femora. Very few, excepting the European *Dolichurus*, and New Holland *Conocercus*, are black. The next family, the *Sphecidæ*, are distinguished by a pedunculated abdomen, which is frequently of great length, and very slender. These insects, like the *Pompilidæ*, also prey upon spiders and caterpillars. *Chlorion* is distinguished for its metallic colours, as also *Pronæus*: the latter, which is African, has large falcated mandibles. The universal *Sphex* appears to contain a second very distinct type, and is connected with *Ammophila* by means of the singular and apparently rare American *Trigonopsis*, named from its triangular and protruded head. Both sections of *Ammophila* are of extensive distribution; and *Pelopæus*, also, has a wide geographical range: this genus forms clusters of cells of mud against walls, and beneath the eaves of houses, and has thence, in America, been called the mud-chick. The next family, the *Bembecidæ*, are remarkable for the anal denticulations of the males; and the venter beneath in this sex has frequently a large curved tooth, and some one or other of the apical joints of their antennæ are hooked. It is upon species of these insects that *Parnopes* of the *Chrysididæ* is parasitical, and which offers the remarkable circumstance of an elongated proboscis, thus resembling the insect upon which it is parasitical. In several of the genera of the *Larridæ*, we observe the two posterior of the three usual stemmata becoming obsolete. *Monomatium* presents us with a petiolated submarginal cell; in *Dicranorhina* we observe the abdomen pedunculated. The excessively active and numerous genus *Tachytes* is found every where but in New Holland, where it seems to be supplanted by *Pison*, which has reniform eyes. In the *Crabronidæ* we are acquainted with several yet undescribed forms, for instance, *Spalagia*, closely allied to *Nysson*; *Sericophorus* to *Oxybelus*; *Nephritomma* to *Trypoxylon*; *Megalommus* to *Gorytes*; *Miscothyris* connecting the latter with *Alyson*; and *Aspidion*, apparently intervening between *Gorytes* and *Philanthus*. An observation or two upon the latter and *Cerceris* will close our rapid survey of the fossorial *Hymenoptera*. The former, although of general distribution, appears to have its metropolis in Africa; as far as it habits are known, it has been observed to prey upon the genus *Apis*. The gay *Cerceris* is, perhaps, of more extensive distribution than *Philanthus*, and certainly extends further north; and the food it stores up as provision for its young consists of small *Curculios*.

(159.) We enter the group of *Vespidæ* by means of *Ceramius*. This group appears to contain a well-defined assemblage of insects, held together chiefly by its tongue, furnished at the apex with glands, and the lateral sweep of its prothorax. Other characters are common to the normal genera, such as to the folding of the superior wings longitudinally and the reniform eyes; but which are lost in some of the aberrant genera, such as *Ceramius*, *Masaris*, and *Paragia*. The *Vespides* resolve themselves into solitary and social tribes, both exhibiting a great variety of structure, and many genera: we can only briefly notice the most conspicuous. The majority of the males of these insects have the antennæ terminating in a recurved hook; in others, this is replaced by that portion curling round; and in others, there are no means of distinguishing it from the same organs of the female, but by the number of its articulations. The typical *Synagris* exhibits a large horn affixed to the base of the mandible of its male; and the same sex of another species has two large curved spines placed beneath the second ventral segment. *Abispa* is apparently the largest of the solitary wasps, and comes from New Holland, whence we have yet seen no genuine *Vespa*, the place of which, Mr. MacLeay says, is supplied by this *Abispa*, the type of which is the *Vespa Ephippium* of Fabricius, synonymous with the *Ab. Australiana* of MacL.: the genus appears to consist of several species. The resembling and numerous *Rhynchium* is very widely distributed, as is also *Odynerus*, which is nearly related to it. *Eumenes*, a solitary and numerous genus, consists of large and usually gaily coloured insects; it has a very long petiole and pyriform abdomen. *Zethus* has a long and exceedingly slender petiole. There is but a slight distinction between *Eumenes* and some of the exotic social genera, such as *Epipona* and other closely allied insects. The distinction consists chiefly in the form of the mandibles, which in *Eumenes* are very elongate, slender, and forcipate; whereas in the social kinds they are more robust and dilated, and denticulated at the extremity. This structure is required to enable them to collect and manufacture the material of which their densely populated nests are constructed, and which are protected by a covering thicker than, but closely resembling, coarse vellum or card-board, which is totally impervious to the vicissitudes of the weather. Within this, the cells are affixed to the under side of horizontal or downwardly curved and parallel layers, which are sometimes formed of a substance similar to the external envelope, but frequently less substantial. Others form their nests of a kind of pale clay intermixed with small particles of the fibre of straw: these nests are of various forms; some conical, with truncated extremities; others rounded, generally ventricose, but sometimes with their sides parallel; but the envelope is always in a continuous sheet, whereby they differ from the genus *Vespa* itself, the envelope of which consists of a succession of layers placed in superposition, that which is most external being the last finished. They are variously situated according to specific peculiarities; sometimes high on trees, or upon low shrubs near the ground. Réaumur has described all the peculiarities of several of these nests; and we are in expectation of having a memoir upon them by Mr. White, who, having all the ample materials at his command which the British Museum affords, will have every opportunity of duly treating the subject, which is one of considerable interest. It has long been known that a species of wasp, the *Vespa Lecheguana*, collects honey in store within its nest. This appeared at first so startling a fact that naturalists would not credit it, until it became confirmed by the testimony of a duly qualified scientific observer, Geoffroy de St. Hilaire, who brought with him to Europe specimens of the insect, as well as of their nest and its contents. The insect itself is identical with the *Brachygastra** *analis* of

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* The name *Brachygaster* having been applied, many years ago, by Leach to the *Evania minuta* Oliv., it is requisite to change the name of the present genus: we therefore propose in lieu of it, NECTARINA.

Perty. We were, therefore, not so much surprised the other day, at finding, upon the section being made of a large nest at the British Museum, that all the inner cells of the intermediate layers were filled with a store of honey. The inhabitant of this nest is a small wasp, its first segment forming a long eumeniform petiole; and it is entirely of a deep black, excepting only its scutellum, and post-dorsolum, which are of a bright yellow. This insect, accordingly, differs considerably from the *Vespa Lecheguana*, in which the first segment is very short, the second exceedingly large and globose, enclosing within it the succeeding segments. The cells wherein this honey is deposited are, of course, of the usual papyraceous material of which wasps' cells are formed; for it is not to be supposed that, because these insects collect honey, they also necessarily secrete wax, for they have no organ whereby the pollen could be collected, and whence, by feeding upon it, wax is secreted; whereas the honey, as in the bees, is congested in their stomachs, and, when it has undergone its proper process, it is regurgitated into the cells which receive it. *Polistes*, a social genus of extensive distribution, but composing very small communities, forms an exposed nest, which consists of a layer of cells attached by a peduncle to either a plant, tree, or wall. It is strange that the genus *Vespa*, which contains the largest and most robust of the social wasps, should form nests of a much more delicate and fragile substance than any of the others. These, as in the others, consist of a succession of parallel and horizontal layers, covered over with a series of envelopes, which give a perfect nest very much of the appearance of a reversed close cabbage. All of these insects are of a courageous character, bold in the resentment of an injury, and which they will not allow to pass with impunity; and their sting, as is well known, inflicts severe pain. There appear to be three different forms of aberrant *Vespidæ*, each of which have but two submarginal cells. In the *Masarides*, which are distinguished by their short knobbed antennæ, the eyes are reniform, and the wings fold longitudinally: this latter character is lost in *Ceramius;* and in a species we possess from New Holland, the eyes become ovate: and in the genus *Paragia* Shkd., which is so like a true *Vespa* as to be easily mistaken for one until closely examined, the wings are never folded, and the eyes are ovate; but it has the glandular tongue, peculiar prothorax, and pulvillulated under side of the tarsal joints, found in *Vespa;* whence we have inferred that it may possibly be the representative of *Vespa* in New Holland. But, if social, the communities will scarcely be large, as but two specimens, each a distinct species, have yet come under our observation; the second differing from the first, formerly described, in being spotted with white.

(160.) The ICHNEUMONIDES constitute the next group of the circle of the *Hymenoptera.* These, as we before remarked, are all parasites, and they form the most numerous division of the order. Amongst them we observe, in their lower divisions, a departure from the typical neuration of the wings; these organs in many becoming entirely destitute of those distinguishing characters. Among the *Chalcidites* we also detect a further departure from the normal, and all but universal, pentamerous structure in the tarsi of the *Hymenoptera.* This group offers, besides, considerable differences of form, the most conspicuous peculiarities of which we shall notice, as it evinces itself in the larger divisions. The tribe of *Ichneumones* are distinguished from all the rest by the confluence of the second discoidal and first submarginal cells of the superior wings; and where there is an intervenient submarginal cell, by that being very small: they also have always two recurrent nerves, and they present varieties of form which we will rapidly survey. 1st. The *Ichneumonidæ* proper have the body elongate, ovate, and depressed; with the ovipositor, which in the whole of this group supplants the sting, not, or scarcely, exserted. It is in this family that the splendid exotic *Joppa* occurs, which in one sex has the antennæ suddenly dilated at its apex, and compressed. 2dly. The *Tryphonidæ*, in which the abdomen is generally clavated, and either subsessile or petiolated, with also a scarcely exserted ovipositor. Two species, the *Tryphon varitarsus* and *pinguis*, carry their eggs attached beneath the apex of the venter. 3dly. In the *Cryptidæ*, the abdomen is always petiolated, and the ovipositor exserted, and usually as long as the body. It is in this family that the genus *Pezomachus* occurs, all of which are apterous. 4thly. The *Pimplidæ* succeed; and in these the abdomen is subsessile and depressed, and usually very elongate, and with an elongated ovipositor, particularly conspicuous in the typical genera *Pimpla* and *Rhyssa;* and *Gl*[illegible] exhibits its abdomen marked above on each segment with two convergent depressions. *Euceros*, in this family, exhibits, like *Joppa* in the *Ichneumonides*, a suddenly compressed enlargement of the antennæ. In the 5th family, the *Ophionidæ*, the abdomen is laterally compressed, and shaped like a scimitar, especially in the typical genera. In *Pristomerus*, in this family, the femora are armed beneath with long spines, — a structure found also in *Odontomerus*, in the next family, the 6th, or *Xorididæ*, which are chiefly distinguished by their globose heads. This tribe is succeeded by the *Ichneumones adsciti*, or *Bracones*. These are distinguishable from the former, by having but one recurrent nervure, and by the second submarginal cell, when extant, being frequently larger than the first. These have been separated into two primary divisions, according to the structure of the mandibles: into, 1st, the *Endodontées*, in which these organs close as usual; and, 2dly, the *Exodontées*, in which they are apparently distorted, curving outwards when closed, and never meeting. The first division have been subdivided into *Polymorphi*, consisting, as their name implies, of insects of a variety of forms, and which seem a convenient receptacle for such as will not associate with the other subdivisions; and here *Streblocera* is conspicuous for its remarkably distorted antennæ. The second division is the *Cryptogastri*, in which the external integument of the abdomen is not usually separated into distinct segments, but consists of one entire piece. 3d, the *Areolarii*, which have a small second submarginal cell, and in the typical genus the mouth is produced into a proboscis; and, lastly, the *Cyclostomi*, in which the clypeus has a deep excision, which, when the mandibles are closed, give it the appearance of a circular cavity. The *Exodontées* we have above sufficiently characterised. They form a very small assemblage of genera, but amongst which *Chasmodon* is remarkable for being apterous, and *Alysia* is the type. Throughout both these large divisions of the *Ichneumonides*, the normal and abnormal, we are acquainted with very many exotic forms which have not yet been characterised. It is, doubtlessly, contiguous to these groups that the eccentric and extraordinary family *Evaniadæ*, comprising within it *Aulacus* and *Fœnus*, are to be inserted. Somewhere in this vicinity, also, those anomalous forms, *Stephanus* and *Pelecinus*, must, of course, come; and in a proximate situation to the *Adsciti* must, we expect, be the place for *Trigonalis*, of which a second form has come under our notice. But time and subsequent discoveries will determine these points.

(161.) We now enter upon the large group of CHALCIDITES, which, in the majority, are minute insects. They comprise an enormous host, the most of which are splendid little creatures gaudily arrayed in the most brilliant metallic colours. It is in this country chiefly that attention has been paid to them, and we must be grateful to Mr. Walker for his elaborate investigation of the tribe. The more typical forms are the least metallic, and are distinguished by their enlarged and elongated posterior femora. *Leucospis* is singular for the recurving of its ovipositor over the abdomen, and from resembling the *Vespidæ* in the superior wings being longitudinally folded. The group exhibits, besides, many peculiarities—not the least of which is the reduced number of the joints of the tarsi in the *Eulophi*; and the whole of them have but an obsolete neuration of the wings. We have already referred to the remarkable *Thoracantha.* Our space admits of no more than alluding to the *Proctotrupidæ,* and the interesting genera they include; and, among others, the ant-like form of *Gonatopus,* with its extraordinarily chelated anterior tarsi; *Inostemma,* with its recurved abdominal spine; and the elegant little *Mymar,* with its pedunculated and beautifully ciliated wings.

(162.) We must spare a few words for the *Chrysididæ,* which present the only instance throughout the *Hymenoptera* of a tubuliferous ovipositor: their bodies, also, are formed in a singular manner, being more or less fornicate; and their abdominal segments are more or less reduced in number, from what we observe elsewhere; and we are acquainted with an African species in which only two are apparent. *Parnopes,* of which we know three species, presents a sexual difference in the number of these segments, the male having one more than the female. It has also an elongated rostrum, like *Bembex,* upon which it is parasitical. These insects are all richly metallic, and they are all parasites; and amongst them *Cleptes* appears to lead off to *Meria* in the circle of the fossorial aculeates.

(163.) The remainder of the *Hymenoptera* are all, in their larva state, vegetable feeders. The *Cynipsidæ,* or gall flies, form a marked and distinct group, although of but limited extent. Their young are reared within the galls which the parent insect produces by the puncture it makes upon the different parts of plants: the juice it instils, and what is secreted by the larva, causes the plant to throw out excrescences, which all differ according to the species which excites them. We cannot here go into their particulars. This group seems to pass, by means of *Oryssus,* through the *Siricidæ,* into our last large group, the aberrant *Tenthredines.* The preceding have all been internal feeders in their larva state; the *Siricidæ* feeding within trees generally of the fir tribe. They are large and conspicuous insects, and present a formidable appearance with their exserted ovipositor. The majority of the larvæ of the *Tenthredines*, however, feed externally upon the leaves of plants, resembling much the caterpillars of the *Lepidoptera;* and, in some cases, they are very destructive to our crops,—instanced in the devastation among turnips, caused by what is technically called the blacks, which is the larva of *Athalia centifolia*. Some of these insects show an indirect connection with the *Cynipsidæ*, for they form and reside in galls; but the paramount distinction of the *Tenthredines*, from all the rest of the *Hymenoptera*, consists in their possessing, in lieu of an ovipositor, a serrated apparatus formed of two parallel plates, and retractile, when not in use, within a sheath at the apex of the abdomen. When in use, they have an alternate motion, whereby their serrated edge perforates the vegetable substance to which it is applied, with a longitudinal incision, wherein they deposit their eggs. The bodies of these insects are always sessile, and generally robust. Their first division, with knobbed antennæ, the *Cimbicidæ*, do not possess the emarginated spine at the apex of the anterior tibiæ, which corresponds with a similar excision in the basal joint of the tarsus, and with which the rest of the *Hymenoptera* cleanse their antennæ: in lieu of this, this division has two spurs at the apex of that limb. Many of the species of this group possess also a couple of articulated spurs, placed half way up the tibia: the apex of all these spurs, and the underside of their tarsi, are very frequently also vesicular: and, when we take into consideration the greater expansion of their wings, and its more elaborate reticulation, and view in conjunction their pedated larvæ, we shall no longer cause surprise at considering them aberrant. The more remarkable genera are, *Perga*, which is exclusively from New Holland, and which broods over its young like a hen over her chickens; *Schizocerus*, with its furcated antennæ; *Lophyrus* and *Pterygophorus*, which have those organs elegantly pectinated in their males; *Tarpa* and *Lyda*, with their enormous heads, and beautifully coloured bodies. Proximate to this group,—but where is doubtful,—should be placed the interesting but perplexing genus *Xyela* Dalm. The abnormal structure in the neuration of its wings, its singular antennæ, with their third joint very much elongated, and its lengthy exserted ovipositor, tend in combination to perplex us, but it appears to be probably the transition from the securiform ovipositor to the valvular one. Having thus finished our rapid survey of the *Hymenoptera*, we can only regret that we could not spare more room for the investigation of so interesting an order. All that we have been able to do in this limited space has been to notice the most remarkable forms, and loosely generalise their most striking peculiarities; and, in doing so, we have preferred dwelling upon those groups which offered the most extensive interest. [(142—163.) W. E. Sh.]

CHAP. V.

THE COLEOPTERA.

ON THE COLEOPTERA GENERALLY.

(164.) THE coleopterous order of insects is composed entirely of those which, in popular language, are called *Beetles;* that is, of insects covered by a hard crust or shell analogous to that of the tortoise, and which, in both, protects the soft parts of the body from external injury. This is manifestly a wise and a merciful provision for their safety, because these insects are not only the most terrestrial of all others of the *Ptilota*, but they are also the most imperfect fliers. From these circumstances, it follows that the *Coleoptera* are more exposed to injury than are any of this class; but, to counterbalance these disadvantages, and to give them a defence which no others enjoy, Nature has clothed them enormous heads, and beautifully coloured bodies. Proximate to this group,—but where is doubtful,—should be placed the interesting but perplexing genus *Xyela* Dalm. The abnormal structure in the neuration of its wings, its singular antennæ, with their third joint very much elongated, and its lengthy exserted ovipositor, tend in combination to perplex us, but it appears to be probably the transition from the securiform ovipositor to the valvular one. Having thus finished our rapid survey of the *Hymenoptera*, we can only regret that we could not spare more room for the investigation of so interesting an order. All that we have been able to do in this limited space has been to notice the most remarkable forms, and loosely generalise their most striking peculiarities; and, in doing so, we have preferred dwelling upon those groups which offered the most extensive interest. [(142—163.) W. E. Sh.]

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(165.) The power of flight enjoyed by coleopterous insects, as before remarked, is much more limited than in any other of the *Ptilota;* while the *Lepidoptera* soar in mid air, and use their feet only as rests to support the body: and, while the *Hymenoptera* transport themselves by flight alone, a coleopterous insect appears to use the limited power of its wings as a last resource, or only upon great emergency. Touch a beetle, and, instead of spreading his wings, he either counterfeits death, or he quickens his pace; but do the same to a moth, a bee, or nearly any other winged insect, and he flies away in a moment. Flight, among the *Coleoptera*, appears, in short, a subordinate faculty. A casual observer would not suspect that a beetle had wings; for they are completely hidden by the two convex plates, or *elytra,* beneath which they lie folded, first longitudinally, and then transversely. These members, among all the other *Ptilota,* are four; but in these insects they are only two in number; their *cases*, or covers, occupying the situation of the larger or superior wings of the other orders. Every thing, in short, points out to us that the *Coleoptera*, in regard to *flight*, are the most imperfect of four-winged insects; and it therefore follows that they are the most aberrant.

(166.) On the other hand, when we look to the strength and structure of their legs, we perceive that the deficiency of *flight* has been amply made up to them in the power of *walking*. No insects run with such swiftness, or retain their hold with so much security. The whole race of predaceous beetles (*Predatores*) are remarkable for their swiftness,—a quality which seems to be one of their typical perfections. The tiger beetles (*Cicindelidæ*) fully illustrate this fact; and every one may have witnessed the rapidity with which the small shining *Carabidæ* course along the footpaths of our fields on a bright spring day. How suddenly again do the water beetles (*Dytiscidæ*) dart down to the bottom of a pool, by the aid of their powerful oar-like legs. In those families, again, which live among foliage, the same strength of foot, and tenacity of grasp, is equally apparent. Whoever has handled a chafer (*Melolontha vulgaris* Linn.) knows how difficult it is to take the insect from the leaf or spray to which, with its long and acutely hooked claws, it tenaciously holds. So admirably, indeed, are the feet of arboreal beetles constructed for grasping, that they will cling to the naked hand with as much ease as to a leaf or a twig. The *Coleoptera*, in short, seem conscious of their superiority in this respect; for, upon all occasions of attack, there are very few which do not depend more upon their feet for escaping harm than upon their wings. These latter members, however, are of great and essential use; though not employed for removing to every short distance, they are always used upon long excursions. When the food upon one tree is exhausted, or the flowers of one plant have been visited, a coleopterous insect crawls to the edge of a slight eminence, and, after a moment's consideration, begins to throw up his elytra, expands his wings, and slowly and steadily mounts into the air. Some few, indeed, of the predaceous tribe, particularly the *Cicindelidæ*, increase the natural speed of their course by alternately flying and running; while others, slow in their motions, counterfeit death, and seem to fall to the ground: this latter, however, is usually but a second deception; for these crafty little creatures generally contrive, by means of their hooked claws, to grasp hold of a leaf or spray, in their fall, and thus save themselves the toil of again ascending to their former station, when the cause of alarm has subsided: these latter habits belong to the greatest part of the *Curculionidæ*, or snout beetles—a family containing several thousands of species. All these circumstances, connected with the use of the feet, lead us to infer that the *Coleoptera*, as a whole, is the most ambulating among the *Ptilota*, and hence peculiarly deserve the name of terrestrial insects.

(167.) The beetles are, perhaps, the most numerous of all the orders. M. Latreille expresses an opinion, that there are probably not fewer than twenty-five thousand already existing in European cabinets; and this number, great as it is, is perhaps not more than one third, or at most one half, of those yet to be discovered. When we consider that each species of this immense assemblage has its own peculiar economy, and its especial task to perform, in the great scheme of creation, the mind is scarcely able to conceive how the form and structure of fifty thousand beetles can be so varied, that no two are alike; still more impossible is it to imagine those delicate shades of difference in their habits and economy, which experience has shown invariably to accompany a difference of species. We should remember, also, that this vast multitude all belong but to one order of insects; which order forms but a small portion of the countless myriads of animated beings, which live and move, and do the work of HIM who made them. The astonishing variety of differently formed creatures which swarm upon the earth, strikes the mind of every reflecting man; although the number of those which he has seen, are but as a unit to the thousands which he has not seen. This interminable diversity of differently formed agents seems, in part, to be explained by one of the fundamental laws of nature, by which it is ordained that the same effect shall be produced by different means and different agents. This truth is too apparent to need illustration, and a slight notice on the economy of the order will confirm the fact.

(168.) In regard to the food of the *Coleoptera*, we find them devouring every thing — each confining itself to some peculiar substance; but if there is any one description of nourishment more especially assigned to beetles, it appears to be that derived from living and decayed vegetable matter, but particularly such as is of a hard and solid texture. The great family of *Capricornes*, or capricorn beetles, not only feed, in their grub state, on the pith, fibres, and internal substance of trees, but many actually saw off, with their strong jaws, the exterior branches, as if to hasten the removal of the decaying tree. Thousands of a more puny race (*Bostrichi*), unable to penetrate the solid wood, take up their residence in the bark, which they perforate in all directions, so that the elements soon effect decomposition, or thus prepare caverns of shelter for other tribes: many, again, have a different office assigned them; their business is to loosen the external bark from the internal wood; and, accordingly, they are only found in such situations. These habits, so essential to facilitate the removal of superabundant vegetation, are almost peculiar to coleopterous insects. But foliage is a more abundant nutriment than wood; and hence we find that thousands and tens of thousands of the smaller tribes live entirely upon the leaves of trees and plants. Flowers appear assigned more particularly to the *Hymenoptera*, the *Lepidoptera*, and the *Diptera*; but several families of beetles are known to partake of this delicate food, and their structure is accordingly fashioned for this purpose: of these, we need only mention the petalocerous or lamellicorn beetles, of which our green rose chafer (*Cetonia aurata*) is a beautiful example. The *Curculionidæ*, a large and very singularly shaped family, live upon the internal juices of vegetables, without encasing themselves in the substance from which they draw their nourishment. All these, however diversified their operations, are phytophagous, or feeders upon vegetables; but, as in every natural group there is a *type of evil*, or in other words, a peculiar division whose habits are rapacious, cruel, and bloodthirsty, so we find, in the order before us, one tribe answering to this description. The predaceous beetles live entirely upon other insects, which they pursue and capture in a living state, or devour when hastening to decay. By far the greater part of these lions and tigers of the beetle world roam about the ground, "seeking whom they may devour," and are hence called *Geodephagous*. Some few, as the *Dytiscidæ*, habitually live in fresh water; from which circumstance they have been named *Hydrodephagous*. It seems, indeed, certain, that a portion of nearly every substance in the animal and vegetable world is assigned as food to coleopterous insects; for not only do they feed upon such things as are produced naturally, but they evince a decided relish for such as are artificially prepared by man. Those families of the predaceous beetles, which are furthest removed from the perfection of their tribe, greedily devour bacon, lard, cheese, and other stores of our kitchen: some show a partiality for leather, even after it has been prepared by the tanner and manufactured by the bookbinder. This is, perhaps, the last indication of the carnivorous habit; and, as natural transitions are always gradual, we find that many of these very insects feed on other substances wholly vegetable.

(169). The structure of beetles is in every way adapted to the various functions we have just enumerated. As their food is of a much more solid nature than that assigned to any other order, we find that they have the strongest and the most complicated jaws, or organs of mastication; thus showing another great departure from the typical structure of the *Ptilota*. They are, in short, of all insects, the most perfect masticators; and had Nature really divided the insect world into two primary groups (*Mandibulata* and *Haustellata*), as some have imagined, the *Coleoptera* would stand at the head of the former. Their actions and habits require great muscular power, and they are consequently endowed with a degree of strength perfectly surprising for creatures so small. If any of our readers wish to verify this fact, let him confine a chafer, or any other beetle, in his clenched hand for a few minutes, and it is ten to one but that the little prisoner, by main force, will effect his escape between the fingers, or, by striking the spines of his legs against the skin, oblige his tormentor to open his hand. Beetles have no stings; but some bite furiously and effectually with their upper jaws, which are pointed at the tips, and serrated or toothed inside: with these they seize their food; which is then masticated by the help of a pair of under jaws (*maxillæ*), and the upper lip (*labrum*), which protects the other organs. The situation of all these is analogous to those in the mouth of a vertebrate animal; and they are accompanied by the feelers (*palpi*), which are either two or four.

(170.) We have said that coleopterous insects are known by the two *elytra*, or sheaths, which cover the wings and body, and which meet in a straight suture down the back; but if *every* insect in the whole order really exhibited this character, Nature would then have made a sudden halt, and would have passed, by an abrupt transition, from a bee to a beetle, or from the *Coleoptera* to the *Neuroptera*. On this, as on every other occasion, the chain of affinity is therefore graduated, and one order of beings is not suffered to stand isolated and unconnected. Hence it is, that, at the confines of this order, we find the coleopterous structure so modified, that some of its distinguishing characteristics begin to disappear. Thus, in the *Malacodermi*, or soft *Coleoptera*, the wing-cases, as the name of the tribe implies, are so thin as to be pliable. In the genus *Meloë*, and several others, they are so small as scarcely to cover one half of the body, nor do they form a straight suture: others, having their wing-cases perfect, are destitute of wings. In *Buprestis*, again, these latter members are so short as not to require a transverse fold; while the females of the glowworms have not the least vestige either of wings or sheaths. It is by these deviations,—few, indeed, in comparison to the bulk of the order, but definitely and strongly marked,—that the graduated scale of nature is preserved in harmony, and the symbols of the animal world are shown. All these deviations either show the passage to the *Hymenoptera* on one side, or to the *Neuroptera* on the other; or they will evince clear and strongly marked types of analogy, by which the other orders of the *Annulosa* and the *Vertebrata* are represented.

(171.) Having now stated the leading distinctions of the *Coleoptera* as an order, and touched upon those particular functions they appear intended to perform, we may inquire what other tribes in the animal creation these insects are intended to represent, or, in other words, what are their true analogies in the scale of animal life. If, in the class of *Ptilota*, we find an order agreeing with the rest in most of their characters, yet possessing only two effective wings, instead of four, we cannot hesitate in pronouncing it the *most aberrant*, or least typical, division of its class. Now, this is precisely the station in nature which the *Coleoptera* appear to hold. Hence it follows, that they should represent all of the most aberrant groups in the animal kingdom. This is not merely a theoretical conclusion, but, as we shall subsequently show, is the result of analysis. We have said that the *Coleoptera*, in their external aspect, have a greater resemblance to the tortoises than to any other vertebrate animals; it must follow, therefore, if this analogy is not a mere fancy, that, on the circle of *Ptilota* (of which this order forms a part) being compared with that of the *Reptilia*, the *Coleoptera* and the *Chelonia* stand opposite to, and represent, each other: this they accordingly do, as seen in the following table:—

Analogies of the PTILOTA *and the* REPTILIA.

Orders of the *Ptilota*.	Orders of *Reptilia*.	
	1. *Typical.*	
LEPIDOPTERA.	OPHIDES.	*Serpents.*
	2. *Sub-typical.*	
HEMIPTERA.	SAURES.	*Lizards.*
	3. *Aberrant.*	
HYMENOPTERA.	CHAMÆLIONES.	*Chamelions.*
COLEOPTERA.	CHELONIA.	*Tortoises.*
NEUROPTERA.	ELANIOSAURI.	*Fish Lizards.*

The fact, therefore, of the beetles being really intended by Nature to represent the tortoises among winged insects, may be safely inferred, because these two groups stand opposite to each other in their respective series; which series, it must be remembered, being founded upon affinity, is entirely independent of all analogous considerations.

(172.) Let us now make another comparison. Every entomologist knows that the *Coleoptera* are the most *gnawing* of all insects: they have the strongest jaws; and both in the larva and perfect state, thousands employ these organs in gnawing solid woods. Where, therefore, do we find, among vertebrate animals, a similar faculty displayed? Obviously in the order *Glires*, or mice-like quadrupeds, named by M. Cuvier, from this very circumstance, *Rodentia*. On placing the series of quadrupeds, therefore, opposite to that of the *Ptilota*, we find these two particular groups come into parallel relations.

Analogies of the COLEOPTERA *to the Orders of* QUADRUPEDS.

Orders of the *Ptilota.*	*Analogies.*	Orders of the *Mammalia.*
LEPIDOPTERA.	Typical.	QUADRUMANA Cuv
HEMIPTERA.	Raptorial.	FERÆ.
HYMENOPTERA.	Social.	UNGULATA.
COLEOPTERA.	Gnawers.	GLIRES.
NEUROPTERA.	Aquatic.	CETACEA.

(173.) It will be curious to see in what manner the armour-like covering of the *Coleoptera* is represented among other animals. The tortoises are covered with horny plates; and if we look among quadrupeds for a similar structure, we have the Indian ant-eaters, and the armadillos of the New World, both protected in precisely the same manner. These latter animals are at the head of the tribe *Edentata*, which is the most aberrant division of the hoofed quadrupeds (*Ungulata*). By bringing these into comparison, we shall here see that the armadillos represent both the tortoises and the beetles, as we have formerly shown.[1]

Analogies of the COLEOPTERA *to* QUADRUPEDS *and* REPTILES.

Orders of the *Ptilota.*	Orders of REPTILES.	Tribes of the UNGULATED QUADRUPEDS.
LEPIDOPTERA.	*Serpents.*	*Ruminantes.*
HEMIPTERA.	*Lizards.*	*Solipedes.*
HYMENOPTERA.	*Chamelions.*	*Pachydermata.*
COLEOPTERA.	*Tortoises.*	*Edentata.*
NEUROPTERA.	*Fish Lizards.*	*Anoplotheres.*

(174.) Our former volumes will have sufficiently established the different circles of the vertebrate animals with which we have now compared the orders of the

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[1] Classification of Quadrupeds, p. 180.

Ptilota, and to those we must refer the reader who is desirous of further details. It would be highly interesting, did our limits permit us to dwell upon all the analogies indicated in these tables; but our present business is with the order *Coleoptera*, and to that only must our remarks be confined. It appears, then, that the three most striking peculiarities of these insects are explained by the most simple process of analogical reasoning. They are covered with natural armour, *because* Nature intends them to represent the reptile tortoises, and the quadruped ant-eaters and armadillos: they have the strongest jaws of all perfect annulose animals, *because* they typify the most gnawing of all perfect quadrupeds, namely, the *Glires*; and they have two real wings only, *because* they are the most imperfect examples of the *Ptilota*. If these analogies are true, they may be extended to hundreds of groups: thus, the *Vermes* are the most tough-skinned class of the *Annulosa*, and are the most aberrant of all the annulose divisions: just so are *Coleoptera* among winged insects.

(175.) The station of the coleopterous order is consequently between those of the *Hymenoptera* and the *Neuroptera*. This conclusion, verified in the foregoing tables, reconciles many of the contradictory opinions entertained by some of our first entomologists. Mr. MacLeay, for instance, has not failed to remark the close resemblance which many ants bear to the beetles; and yet it is probable that the true passage between the orders is made by means of the small parasitical ichneumons and gall-flies, forming our tribe *Chalcides*. Some of these have the thorax prolonged into a plate or spine, which extends the whole length of the body; so that they put on the very form of a *Mordella*. Among the many singular insects discovered by us in Brazil, is a species of this group, which is so completely disguised in this way, that most persons would consider it, at *first* sight, as a new sub-genus of *Mordella*, having the antennæ pectinated. On the other hand, Nature leaves the *Coleoptera* for the *Neuroptera*, by means of the earwigs (*Forficulidæ*),—a passage so apparent, that it has been recognised by almost every writer since the days of Linnæus.

(176.) Having now sufficiently treated of the *Coleoptera* as an order, we may look to its component parts. On examining the structure of the feet of these insects, several remarkable differences will be perceived. In some, the tarsi, which may be said to represent the human finger, consist of four distinct cylindrical joints, terminated by a forked hook or claws; while in others, these joints, apparently *, are only three or two, and, instead of being rounded and simple, are flattened and two-lobed. Now, it is obvious that insects which belong to the first of these groups, — that is, having the tarsus altogether composed of five distinct joints, — are the most perfect in the construction of their feet; just as insessorial birds (*Insessores*), and four-handed quadrupeds (*Quadrumana*), are the most perfect of their respective classes. All the great systematists of the present day tacitly concur in this opinion, by placing the pentamerous, or five-jointed beetles, at the head of their systems. Yet among these, again, we find two very different races; — one composed of insects living upon vegetables; while the other comprehends all such as subsist by pursuing and devouring their weaker brethren, just as do the feline tribe of quadrupeds, or the falcons among birds. Here, then, we see the two great divisions of the pentamerous *Coleoptera*. The first, pre-eminently typical, herbivorous, and harmless, constitute the tribe of *Lamellicornes*: so called from the shape of their antennæ, which are short, clavate, and lamellar. The second, which is the sub-typical tribe, are predaceous, or live upon animal substances: these form our tribe of *Predatores;* and have their antennæ longer, filiform, and composed of lengthened joints. All other *Coleoptera* come under the aberrant division of the order, composed of those tribes whose tarsi have almost always less than five joints, all of which, excepting the last, are generally flattened and lobed. Among these, again, we find three natural subdivisions or tribes. The first are the *Capricornes*, or lignivorous beetles; the most striking character of the perfect insect being the great length of their antennæ, which are unusually robust, and generally curved, like those of goat or sheep. The second tribe are the *Malacodermes*, or soft-winged beetles; whose elytræ are soft, flexible, and often very short. The third and last we shall name the *Monilicornes*: they are to be known by a short, thick, oval, or hemispherical body, with the antennæ moniliform. Such are the most prominent or typical distinctions of the five great tribes of coleopterous insects, under which we shall arrange the whole order. Before, however, we proceed to enter more fully into details, it may be as well to throw these characters into a tabular form, and designate the groups in a more scientific manner.

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* We say *apparently*, because there is reason to think that most insects have the full number, but that some are in a rudimentary state.

Primary Divisions and Analogies of the Order COLEOPTERA.

Tribes of the *Coleoptera*.	*Typical Characters.*	Orders of the *Ptilota*.
	1. *Typical.*	
LAMELLICORNES.	Tarsi five jointed; antennæ clavate; herbivorous.	LEPIDOPTERA. *Papilio.*
	2. *Subtypical.*	
PREDATORES.	Tarsi five-jointed; antennæ filiform; carnivorous.	HEMIPTERA. *Pentatoma* Latr.
	3. *Aberrant.*	
MALACODERMES.	Body particularly soft.	NEUROPTERA. *Libellula.*
MONILICORNES.	Body short, ovate, frequently hidden beneath the shell.	COLEOPTERA. *Cassida.*
CAPRICORNES.	Antennæ very long; larva apod, enclosed in other substances.	HYMENOPTERA. *Apis Ichneumon.*

(177.) The *Monilicornes*, which include the tortoise and ladybird beetles (or the genera *Cassida* and

Coccinella of Linnæus), are more protected than any others, by that hard covering which is peculiar to the *Coleoptera*. It might, therefore, be supposed that they should stand at the head of the order; but this inference by no means follows. Superior perfection of structure is the only true and certain distinction of typical pre-eminence: this we consider as one of the first aphorisms in the Natural System; for it is that which places the *Quadrumana* at the head of the *Mammalia*, the *Insessores* as the type of birds, and the *Ptilota* as the first of the *Annulosa*: it is equally manifest in the least of Nature's groups, as in the greatest; for it is by this rule that the animal kingdom takes precedence both of the vegetable and the mineral. This perfection of structure in typical groups implies the possession of a greater number of faculties, and, therefore, a more complicated organisation, than is enjoyed by the rest; but, in aberrant groups, this perfection is confined only to some one property, which is always accompanied by a diminution of others. Of this latter fact, a familiar example, out of hundreds which might be adduced, will suffice. The *Scansores*, or climbing order of birds, is an aberrant group: the perfection, therefore, of this group is confined to one particular quality, — that of climbing; and this quality, being most conspicuous in the parrots and the woodpeckers, places these birds at the head of their own order. In like manner are we to judge of the rank of the monilicorn beetles. That they may represent the *Coleoptera*, when the contents of the whole order are compared with the other *Ptilota*, Nature has developed in them *one* of the leading distinctions in a most extraordinary manner; for, in the *Cassidæ*, we find the members of the body concealed beneath the shield of the head and the wing-cases; and they thus so closely resemble a chelonian reptile, that, in all countries, they have acquired the name of tortoise beetles. Yet, notwithstanding this great developement of this *one* character, we find a proportionate diminution of others; particularly in the feet, which have only four apparent joints; and one of these, in a true neighbouring genus, *Coccinella*, is evanescent. We see, therefore, in both the instances here produced, an illustration of the same law. The scansorial birds, except in climbing, are as inferior to the perchers (*Insessores*), in all other points of general organisation, just as the monilicorn beetles are inferior to the tribes of *Lamellicornes* and *Predatores*.

(178.) Nothing is, perhaps, more instructive, or more interesting, than to trace the extraordinary manner in which the natural arrangement of one order of beings harmonises with another, from which, in point of general appearance, it appears, *toto cœlo*, to differ. Who would imagine, that, among coleopterous insects, we should find a perfect representation, not only of the leading groups of the *Lepidoptera*, but also of those of the diurnal butterflies? Yet such is truly the case: the latter set of analogies, in fact, are dependent upon the former, as will be seen by the following comparison: —

Analogies of the COLEOPTERA *to the* LEPIDOPTERA.

Tribes of the COLEOPTERA.	*Typical Characters.*	Tribes of the LEPIDOPTERA.
	1. *Typical.*	
Lamellicornes.	Antennæ clavate.	*Papiliones.*
	2. *Sub-typical.*	
Predatores.	Antennæ attenuated	*Sphingides.*
	3. *Aberrant.*	
Malacodermes.	Body, either in the larva or imago state, particularly soft.	*Noctuides.*
Monilicornes.	Larva vermiform, or onisciform; leap entirely or partially.	*Phalænides.*
Capricornes.	Antennæ greatly developed.	*Bombycides.*

The soft-bodied *Coleoptera* thus find their representatives among the larvæ of the *Noctuides;* which, as a whole, are the most soft and naked of all the lepidopterous caterpillars. The looper moths, as they are called, or the *Geometria* of Linnæus, are well known to move by a sort of leap; and almost the only *Coleoptera*, which really possess this property, belong to the *Monilicornes*, where we have the whole family of *Halticidæ*, with their thickened thighs. The largest beetles are among the *Capricornes*; and the largest *Lepidoptera* are types of the *Bombycides*. In both these groups, also, we find the antennæ more developed than in any other insects: in some of the capricorn beetles, they are five times the length of the body; while, in the silk moths, or *Bombycides*, their structure is particularly complicated.

(179.) We must not be surprised, however, in submitting a natural group to many and diversified tests, that some analogies are more remote than others; and that others can be traced only in one stage of the insect, and not in another. To show this more clearly, as an inevitable consequence of general analogies, we shall next compare the tribes of the *Coleoptera* with the families of the *Diurnes*, or true butterflies.

Analogies of the COLEOPTERA *to the* DIURNAL LEPIDOPTERA.

Tribes of the *Coleoptera*.	*General Analogies*.	Families of the DIURNES.	Tribes of the *Lepidoptera*.
LAMELLICORNES.	The most perfect in general structure.	*Papilionidæ*.	PAPILIONES
PREDATORES.	The most eminent for strength.	*Nymphalidæ*.	SPHINGIDES.
MALACODERMES.	Body soft.	*Hesperidæ*.	NOCTUIDES.
MONILICORNES.	Larva onisciform.	*Erycinidæ*.	PHALÆNIDES.
CAPRICORNES.	Antennæ very long.	*Satyridæ*.	BOMBYCIDES.

Every entomologist knows that the body of the Hesperian caterpillars are so soft, and the skin so thin, that the vessels can be seen through it; and that the insect itself, being so little adapted to resist external injury, protects its body by artificial means, and lives concealed within a rolled leaf: the *Hesperidæ*, in fact, are the soft-skinned butterflies, just as are the *Malacodermes* among the *Coleoptera*. The next analogy—or that between the *Monilicornes* and the *Erycinidæ*—is, perhaps, one of the strongest that can be found. The caterpillar of a *Cassida*, or tortoise beetle, so completely resembles that of an Erycinian butterfly that they might both be taken for examples of the same tribe of insects. Great developement of the appendages to the head invariably accompanies all those animals which represent the capricorn beetles; whether these appendages are horns, as in quadrupeds; crests, as in birds; or antennæ, as in winged insects. Hence it is, that the antennæ of the *Satyridæ*, or wood butterflies, are longer in proportion to their body, than those of any other *Lepidoptera* in existence. Our own cabinet, peculiarly rich in this splendid tribe, enables us to state this fact with confidence; and the analogy receives still greater confirmation, by the larvæ of these butterflies being provided, in almost every instance, with spines on their heads, or appendages to their tails. It thus appears that the arrangement we now propose, for the first leading tribes of the *Coleoptera*, is in perfect unison with that system upon which we have arranged the animal creation, throughout which it cannot be doubted that one uniform plan, perfect in all its parts must prevail.

CHAP. VI.

COLEOPTERA, *continued.*

THE LAMELLICORNES.

(180.) We may now take a more particular survey of these tribes; and endeavour to resolve these, also, into their respective families. The LAMELLICORNES, or beetles with clavate and lamellate antennæ, and five-jointed tarsi, stand as the pre-eminent tribe of the coleopterous order: they may be further recognised by the compression of the tibiæ, or shanks, which are more or less toothed on their exterior edge. The antennæ are remarkably short; and so much bent, either towards the middle (as in the *Lucanidæ*), or at the club (as in *Cetonia*), that the two portions form an angle more or less acute. No general characters can be more definite; and it is only in the most aberrant divisions that we find any material exceptions. The habits of all this tribe are herbivorous; that is, they feed entirely upon vegetable matter, either in a green or decomposed state; while, amid great diversity of form, size, and colour, we find some of the most splendid as well as the most bulky *Coleoptera* yet discovered. The *Cetonia aurata*, or the common rose beetle, may be taken as the type of the whole. A glance at this beautiful, although common insect, will convey a better idea of the general shape of the lamellicorn beetles, than the most laboured description. As to their history and natural arrangement, we owe all that is of permanent value to the admirable work of Mr. MacLeay. Assisted by his arrangement of a part of this tribe, but adhering to those general laws we have traced so extensively in other portions of the animal world, we shall now lay before the reader the result of our own researches in this most interesting group of insects. It may be as well to mention, that the *Lamellicornes* compose the "Chilognathiform Stirps" of Mr. MacLeay, as detailed in the work above mentioned.

(181.) The two families of CETONIADÆ and SCARABÆIDÆ, as it has long ago been demonstrated, compose the typical and sub-typical families of the lamellicorn beetles. They consequently possess, in their full developement, all the characters here assigned to the tribe. The *Cetoniadæ*, from living on the fresh sap of plants, have been termed *Thalerophagous*.* Their colours, in harmony with the delicacy and pureness of their food, with few exceptions, are elegantly varied, or uncommonly splendid. As a further distinction, Mr. MacLeay mentions that the elytra do not, as in the *Scarabæidæ*, entirely cover the abdomen: this, however, although a useful, is but a secondary, and very uncertain character; inasmuch as we are entirely ignorant how far this deviation of structure is connected with the habits of the insects in question. As the *Cetoniadæ* feed upon living vegetables, and the *Scarabæidæ* upon such as are decomposed, the student may naturally inquire how these distinctions are to be traced in the cabinet of the entomologist who may be altogether ignorant of this difference? and what are the *external* characters which accompany such a dissimilarity of habit? These, at least, were the first questions that occurred to us, many years ago, upon commencing the study of the lamellicorn tribe. We cannot discover, however, in the valuable pages of the *Horæ Entomologicæ*, any information which supplies this knowledge. Nevertheless, it may be safely stated, that Nature has marked these two families, in their external structure, in as remarkable a manner as she has done in their economy. This difference is manifested in the construction of their tarsi. The *Cetoniadæ* are arboreal beetles; that is, living and moving among those trees, plants, and flowers, which are their natural food. Their feet are accordingly constructed for clinging to objects which afford them such an uncertain footing. The terminal joint of the tarsi, on which are the claws, is that in which the greatest strength is necessary; and it is therefore invariably longer and stronger than any of the others. Hence these insects cling with the greatest pertinacity, frequently by only two or three of their feet, to any object they catch hold of. The more equal articulation, also, of all their legs, gives to these members a freedom of motion which is denied to all other of their affinities. In the genera *Cetonia* and *Rutelæ* (which, as being types of the family, possess this structure in the greatest perfection), the claw joint is sometimes as long as the total length of all the others; and even in the more aberrant groups, the united length of all the tarsi is fully equal to that of the shank. Now, all these characters, in the *Scarabæidæ*, are completely reversed. Hence it is that [illegible] two families admit of the most simple as well as natural, definition. The entomologist, in short, has only to remember, that in the arboreal, or *Thalerophagous Cetoniadæ*, the tarsi are as long, and generally longer than the shank; while in the terrestrial, or *Saprophagous Scarabæidæ*, the tarsi are invariably much shorter than the shank: in other words, that they are long in one, and short in the other. Having now sufficiently defined the present family by its typical peculiarities, we may proceed to its next subordinate divisions, or sub-families. These, with but one exception, we shall distribute according to the arrangement developed by Mr. MacLeay; not that the groups themselves have yet been studied with that precision which they require, but because, so far as we have verified this theory, we find it, with but one exception, to harmonise with the general plan upon which all the great divisions of the animal kingdom are founded.

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* As this group, however, seems to correspond with such as we have termed families in other divisions of the animal kingdom, and as uniformity of nomenclature is so highly desirable in all branches, we shall on this, and all other occasions, take the family name from that division which is the most typical. See our remarks on the rank of groups, in *Classification of Animals*, p. 373.

(182.) The five principal groups, or sub-families, of the *Cetoniadæ* are as follows: — 1. the *Cetonianæ*, or floral beetles; 2. the *Rutilinæ*, or metallic beetles; 3. the *Megasominæ*, or horned beetles; 4. the *Melolonthinæ*, or tree beetles (chafers); and, 5. the *Glaphyrinæ*, or wasp beetles. The error, as we conceive, which has caused the substitution of the *Anoplognathidæ* (MacLeay) for the *Megasominæ* (Sw.), will be subsequently noticed. It may safely be asserted, that the arrangement of this and the subsequent family is the only portion of systematic entomology which has been founded on an imperishable basis. Enlarged conceptions, indeed, of the general laws of nature are fast gaining ground; but it is not among those who yet tread in the beaten path of isolated classifications, and disconnected nomenclature. It is the rising generation of naturalists, who begin to study the philosophy of their science, and who, in a few years, will make a complete revolution in entomological science. The stream of oblivion has already passed over the entomological systems we ourselves once cherished; and the time is fast approaching, when no system, whatever it may be, which is not founded on the general harmonies of nature, will be regarded by any but mere nomenclators. In this mighty revolution of zoological science, we venture to predict, that the arrangement of the typical *Lamellicornes*, above alluded to, will remain, in all its distinguishing features, the same, — simply because it is natural. For this reason, we shall devote as much space as possible to the developement of these families. Besides, the theory of their arrangement is equally applicable to all other natural groups; so that when once fully understood, the entomologist, in a great measure, will be prepared to investigate any other on the same principles. With this object, we shall now briefly notice, in further detail, the sub-families of the *Cetoniadæ*; giving to them those names which point out what we consider their relative value with other groups.

(183.) The CETONIANÆ, or floral beetles, on account of the very wide geographic surface over which they are distributed, joined to other considerations, appear to be more typical than the sub-family *Rutilinæ*, whose limits are almost entirely restricted to the New World. The *Cetonianæ*, on the contrary, are common in Europe, Africa, Asia, and Australia. They are at once distinguished by the membranaceous texture of the mandibles and maxillæ; a structure which proves that these insects, in the perfect state, are intended to live on vegetable juices. The *Cetonia Morio*, and probably many others of the darker coloured species, regale on the sap which flows from the wounds of trees; while the rose beetle (*C. aurata*), and its more brilliant companions, are only to be found on flowers.* Mr. MacLeay is of opinion that *Trichius* may, with safety be regarded as a natural group in this division, although the larvæ of these beetles live in putrescent wood. The *Cetoniadæ* may be distinguished, anatomically, from the *Glaphyridæ* (MacLeay), by having their labrum concealed under the clypeus; whereas these last have it exserted, and very prominent. The larvæ live in the richest vegetable soils; and the perfect insects, as before remarked, are gaily and elegantly coloured, although rarely possessing that metallic brilliancy which belongs to the next sub-family.

(184.) Although we have just said that this family presents a less metallic appearance than the following, it must be applied only as regards its genera; for many of the species, certainly, cannot be exceeded in beauty, and, indeed, vie with any in the resplendency of their decorations, especially in the genus *Cetonia*, as also in some of the *Goliathi*. Among the anomalies of form in this group, we may mention the cornuted thorax of *Cetonia* (*Ischnostoma*) *cornuta* Fab., which Mr. MacLeay considers as osculent between the two genera; besides which relation, we may observe that it points certainly very strongly to *Pachycnemus*, by its thickened posterior legs. A tuberculated thorax we also find in

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* Hor. Ent., 74.

Osmoderma Eremita, which is the largest European insect in the group; and which emits, we are informed, when handled, a powerful scent of Russia leather.* A greatly produced clypeus is not an uncommon characteristic, and is conspicuous in *Goliathus*, *Ischnostoma*, *Inca*, &c.: this is usually a falcated process, with basal ramifications, or it assumes the form of a cross; it is, however, exclusively restricted to the male insect. The genus *Cryptodus*, which MacLeay originally placed among the *Trogidæ*, he has latterly been induced to move into this group, proximate to *Cremastocheilus*; the habits of the latter of which, he says, from personal observation on the banks of the Delaware, are to fly, like *Cicindelæ*, over the sand which there (opposite Philadelphia) lines the bank of that noble river. They are certainly not flower-frequenting insects; and what they find in the sand to their taste, I do not know.† It thus appears not improbable, from the affinity of *Cryptodus* with this genus, and from the analogy of the structure of the mouth of *Cryptodus* to the *Trogidæ*, that the habits of the latter genus may be identical with those of *Cremastocheilus*. The excessively flattened and broad form of *Platygenia* (MacLeay) presents another remarkable aberration from the typical structure of the group, wherein also, we see a curvature of the legs, perhaps only in the male; and in *Campulipus* (Kirby) this male characteristic increases so much, that the intermediate tibia is bent into an obtuse angle. The other most remarkable genera are *Lepitrix*, for its mimicking resemblance of that section of the gigantic *Goliathi* to which the *G. giganteus* serves as type; and *Anisonyx*, for its extreme hairiness, which makes it completely the bear among the *Cetoniadæ*. It is a genus peculiar to the Cape of Good Hope. We have above alluded to the enormous developement of the posterior legs in *Pachycnemus*; but we may here further remark, that they are, perhaps, quite as large in proportion, as those of *Repsimus* among the *Anoplognathidæ*, — a family distinguished for that peculiarity. We can now only further notice the extraordinary abridgement of the elytra in *Valgus*, the females of which possess an elongate slender exserted ovipositor; and the parallelism of *Inca*, in America, to the genus *Goliathus* in the Old World; but upon this last gigantic genus we shall have further occasion to say a few words below. [W. E. Sh.].

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* A circumstance very unusual in the lamellicorn *Coleoptera*.

† MacLeay's Illustrations of the Zoology of South Africa, "*Annulosa*. 4to. Lond. 1838. p. 17.

(185.) The *Rutilinæ*, in their general aspect, have much resemblance to the insects of the last division; but their mandibles are not only, in most instances, prominent, but much stronger, while their texture is horny, and not membranaceous: this latter, as it has been observed, is "an obvious and easily seized character of separation;" but it is one, unfortunately, which requires not only great anatomical skill in the detection, but inevitably leads to the mutilation and injury of the specimen. In our opinion, a more easy, and therefore a preferable, distinction can be drawn between the two groups, by attending to the structure of the feet. In the *Cetonianæ*, the tarsi are comparatively slender, and the claw joint is always shorter than the length occupied by the four preceding ones. In the *Rutilinæ*, on the contrary, the tarsi are remarkably thick, the basal articulations very short, and the claw joint so large and long as to be equal in length to all the others. We, of course, include the genus *Anoplognathus* in this definition of the *Rutilinæ*; for, so intimately is it connected to this group, that even Mr. Mac Leay admits "we shall experience no trifling difficulty in the attempt to separate them." The typical *Anoplognathi* are almost exclusively found in New Holland, and are among the most splendid metallic insects of this family, — shining with green and golden reflections, changeable in every position. We know little of their history; but we have heard that the most common species, round Sydney, fly during the dusk of the evening. The *Anoplognathi*, indeed, have the mandibles concealed beneath the clypeus, and the tips of the maxillæ more obtuse. But the general aspect of these insects, and more especially the construction of their feet, are so much in unison with the *Rutilinæ*, that they carry the appearance of belonging to the same natural division, rather than of being types of a distinct sub-family. This, at least, is the opinion acted upon in all the modern works wherein these insects are mentioned. True it is, that such opinions, unsupported by demonstration, cannot possess a paramount authority; and it unfortunately happens, that every one of the sub-families of the *Cetoniadæ* require to be analysed, their minor divisions or genera defined, and their analogies worked out. That there is, in many points of structure, a resemblance between the *Anoplognathi* and the *Dynastidæ*, cannot, for a moment, be questioned; but this resemblance, as we shall subsequently endeavour to demonstrate, is of a subordinate nature.

(186.) The most conspicuous genera in this exceedingly elegant family are, in the first place, *Chrysina*, distinguished for its golden green vivacity, whence it has derived its name; and to which genus the celebrated *Scarabæus Macropus* is to be referred as the male. This name Mr. Francillon applied to it, in consequence of its greatly thickened and elongated posterior legs; thus exhibiting a strong analogy to the kangaroo, but certainly in developement only, and not in function, as the insect does not leap. This insect, which was so long considered an inestimable treasure, has recently become comparatively common, from the importation of a great quantity from Mexico. The whole of this family is, however, distinguished by the enlargement of the posterior legs in the males, which is especially the case in *Repsimus*, *Anoplognathus*, and *Chrysochlora*. *Anoplognathus*, Mr. MacLeay surmises, may constitute, in its larva state, a considerable article of food to the barbaric natives of New Holland, where the type of it must occur in great profusion. *Geniates*, which has been referred to this family, we consider as belonging rather to the *Melolonthidæ;* and where, consequently, we shall notice it. *Macraspis* and *Chasmodia* offer us, here, the greatest developement of the scutellum observable among the *Petalocera*, and the large Peruvian *Chrysophora Chrysochlora* may vie with all in external beauty. It is of a deep rich coppery green, which takes a golden tinge upon the upper surface of the body, agreeably deadened by the innumerable punctures with which the insect is covered. Further, the very remarkable *Heterosternus*, which, divested of its antennæ, upon a superficial glance, might pass for a *Buprestis*, and whence it has its specific name; and the anomalous genus *Hexodon* — the country of which has only recently become known to be Madagascar — one metropolis of extraordinary forms. Three species we are now acquainted with, and they are found in tolerable plenty upon the sandy coasts of that island. [W. E. Sh.]

(187.) The *Megasominæ* are the largest beetles of this family; and, both from their size and shape, are in no danger of being confounded with either of the preceding. The species, comparatively, are few, — at least, of such as exhibit the typical characters. They are all natives of hot countries, chiefly those in the New World; and, from what little is yet known of their economy, feed, in the larva state, within the hollows of decayed trees, and in putrescent wood. The perfect insects are clearly arboreal, for their tarsi are all constructed for clinging to vegetables: the articulations are cylindrical; and the first joint, as in all the preceding divisions, is much shorter than the last. In nearly all these gigantic beetles, either the males only, or both the sexes, have singular horn-shaped processes, rising from the head and thorax, giving to them a very grotesque and even formidable appearance. In this respect, they so closely resemble the genuine *Dynastidæ*, belonging to the corresponding sub-family of the *Scarabæidæ*, that, to this day, all entomologists have overlooked those positive distinctions manifested in the different construction of their tarsi. It may be further remarked, that the colours of the *Me*[illegible] are sombre, being generally of a dull or livid green.

(188.) This family is remarkably distinguished by, besides their gigantic bulk, the processes which almost universally, and with but rare exceptions, arm the head and thorax of their males. The use of these appendages has not been ascertained, if use they have beyond the sexual distinction, which we may scarcely doubt. A similarity of structure in these frequently grotesque excrescences is but rarely found to be identical, even in cognate species; and this circumstance has led to the investigation of the character of the trophi, where as remarkable differences have been discovered, as in their external and more obvious distinctions. These, consequently, have led to their subdivision into genera: perhaps upon quite as good grounds for separation, as what are now so extensively adopted throughout the animal kingdom. Nature, in her variety, has always an object; empty exhibition we should no where find, could we follow her into her laboratory, and there observe the recondite uses which mould form; for she, like the ancient philosophy, has her esoteric and her exoteric doctrines; and until we shall have become the hierophants of her temple, the mysteries of the former will remain inexplicable to us. This family is still called *Scarabæus* by the majority of Continental entomologists; but the application of this name, Mr. MacLeay very consistently restricted to those insects which truly represented the *Scarabs* of the Ancients, the object of worship to the Egyptians. He then gave to the present the name of *Dynastes*, thus electing them RULERS of the insect world; as it was customary for nations, before the sophistication of hereditary primogeniture, to select their princes from their most gigantic and powerful compeers. To this name we have, however, given a still further restriction, beyond what it receives by the separation of the following genera, and many others into which it has recently been divided. *Xylotrupes*, type *Sc. Centaurus; Golopha*, type *Sc.*

[illegible] *Megasoma*, type *Sc. Actæon*; *Megaceras*, type *Sc. Chorinæus*; *Chalcosoma*, type *Sc. Atlas*; *Strategus*, type *Sc. Alœus*; *Temnorynchus*, type *Sc. Coronatus*, &c. &c. We may further notice the excessive elongation of the anterior tibiæ and tarsi in the genus *Eucheirus* Kirby, the type of which is the *Sc. longimanus*, and the semi-metallic *Agacephala* with its deeply furcated head. [W. E. SH.]

(189.) The *Melolonthinæ*, or tree beetles, generally called chafers, appear to follow the last, whose lengthened and slender tarsi (so different from that of the *Rutilinæ* and the *Cetonianæ*) prepare us for the great developement of these members universal in the present group. Notwithstanding that a contrary opinion has been expressed, we consider the *Melolontha vulgaris* of Britain, or the chafer of the country people, as one of the true types, to which that of *Serica* is subordinate. The chief distinction of the *Melolonthinæ* MacL., is their very convex or sub-globose form, — "in which respect they exhibit an excellent parallel to the *Trogidæ*." Great stress has been laid on these insects possessing a transverse suture, "which divides the clypeus into two parts, just before the eyes;" but as it is also admitted that this character is likewise common to the whole of the *Anoplognathi*, and the greatest part of the *Rutilinæ*, we do not perceive how it can be selected as any peculiar character of this group. So far as we have yet proceeded in our analysis, it appears to us that one of its most typical distinctions is found in the lengthy developement of the legs, — a structure admirably suited to the arboreal habits of the insects. The *Melolonthinæ*, for the most part, are dull coloured, being dark brown, or assimilating to the colour of the earth. It is said that they mostly frequent sandy soils —probably in the larva state, for the beetles themselves, as it is well known, are invariably met with in trees: the structure of the feet, in short, is by no means adapted for walking upon an even surface; hence the perfect insects are strictly arboreal: the tarsus is longer than the shank, with the first joint scarcely half the length of the last. These characters, joined to the convexity and pubescence of their bodies, seem to afford the best external distinctions of the *Melolonthinæ*. Their food consists almost entirely of leaves; and they occasionally appear, at uncertain intervals, in amazing swarms. It is, perhaps, one of the most widely distributed groups of the arboreal beetles; since we have before us typical species from Africa, India, America, and Australia: they seem, however, to be more abundant in temperate than in tropical countries. The only form which we have yet seen, possessing a rudimentary horn on the thorax, is the genus *Pachypus* of Fabricius, which we have occasionally captured in Sicily: it is, perhaps, by this genus that the *Melolonthinæ* are united to the *Megasominæ*.

(190.) It is a very remarkable circumstance, that a distinguishing feature of the entomology of Southern Africa is the hairy clothing of the majority of its contents. Of this we have a strong exemplification in this family, in *Cephalotrichia* Kirby, the type of which is *Melolontha Alopex*, in which all parts of the insect, excepting its elytra, are densely covered with very long down. The general aspect of these insects, both in form and colour, is dull and heavy, — instanced in the type *Melolontha* itself. Of course, exceptions occur; and yet, notwithstanding this circumstance, they appear to have a compensation in the great beauty of the elegantly lamellated antennæ in the majority of the males. The dilated tarsi are clothed beneath with hair in the genus *Geniates*, and which is a structure of very rare occurrence in the *Petalocera*; it, however, is found only in the male insect. Many *Hopliæ* are beautifully enlivened with delicate metallic tints, arising from their dense clothing of scales; and the little New Holland *Diphucephalæ* are equally distinguished for their metallic brilliancy, which, however, is not of so fragile a nature as in the last, — it being the integument itself which is thus coloured. The British *Serica* is very delicate in texture; and some of the African species are singular for their globose form. We have already above alluded to the *Cœlodera* Dej. (*Pachypus*) of Southern Europe, which is so different to its male, that it is not long that they have been united by entomologists; the abdomen of the female, compared with the insect, is very vesiculose; and it has neither elytra nor wings. [W. E. Sh.]

(191.) The *Glaphyrinæ*, or wasp beetles, follow next in the series. Their typical distinction is the unusual shortness of their elytra, and their soft semi-membranaceous texture: these characters, indeed, are common to all coleopterous insects analogous to this type; but, among the arboreal *Cetoniadæ*, they are altogether restricted to this division. Another, and a very remarkable peculiarity, is the extreme hairiness of these beetles, —a structure by which they are enabled to perform the office of bees, in promoting the fœcundation of plants. This, and the following facts regarding the *Glaphyrinæ*, we can state as the result of personal observation.—On the flowery plains of Sicily, and more particularly of Greece, several species of *Amphicoma* are found in the greatest profusion during the early spring months: they are to be seen on the wing very early in the morning, flying about from flower to flower, and apparently very busy. There is one species, more especially, found in different parts of Greece, which is, without any doubt, the *Melolontha* of the Ancients; so completely does this insect, when in motion, resemble one of the hymenopterous order, that we captured it under that belief, and only then discovered it was a beetle. After the month of May, not one of the many *Glaphyrinæ* of those countries are to be seen; and even at the proper season, they seem all to retire before the middle of the day. ' During the early part of May, the plains of Athens may be said to swarm with these green and yellow *Glaphyri*, so that the entomologist might collect them by thousands. Mr. MacLeay, unacquainted with the fact, supposes that the *Trichius fasciatus* was the insect alluded to by Eustathius; but, independent of the existence of the species just mentioned, the *Trichius fasciatus* does not appear to have such a southerly range — at least, it was never seen by us, either in Sicily or Greece, during a residence of near seven years in different parts of those countries. In regard to the geographic distribution of this group, it seems confined to the Old World, and within zones of 25° breadth on each side the tropics. Mr. MacLeay further adds, that "the membranaceous process of the maxillæ, the exserted labrum, and subquadrate clypeus, will serve to distinguish them easily from the *Melolonthidæ*, with which they have a most obvious connection.

(192.) The genera of this family are very few in number, and of which we have nothing further to record beyond what we have observed above. We will merely remark, that here the length of the legs furnishes the features which their thickness supplied in the *Rutilinæ;* and which, in the *Megasominæ*, is replaced by the tuberculated and cornuted head and thorax, and in the *Melolonthidæ* by the enlarged developement of the male antennæ; and this characteristic in the *Cetoniidæ* presents itself in the large developement of the mesothoracic epimera. Before we quit the thalerophagous circle, we will take a retrospective glance at the relative proportions of the genera and species contained in each. The *Melolonthidæ* stand pre-eminently the first; for their numbers are more than double those of either of the other families, and more than equal to the whole combined. Next follow the *Cetoniidæ*, in which there is a greater uniformity of general structure; but *Cetonia* itself is the most numerous genus of the circle. The *Rutilinæ* follow the last in the proportions of form, but the *Glaphyridæ* stand very low below either; and the relative proportions of species, in round numbers, are, *Melolonthidæ*, 26; *Cetoniidæ*, 14; *Rutilinæ*, 6; and *Glaphyridæ*, 1. [W. E. Sh.]

(193.) Such are the characters we have selected for the five sub-families of the *Cetoniadæ*, or those beetles (*Petalocera Thalerophaga* MacL.) which feed upon living vegetables. We shall now show in what manner these groups represent the great tribes of the *Coleoptera*, and what analogies they bear to other orders of created beings. On the assumption that the *Cetonianæ* are pre-eminently typical, we may place the rest in the same series in which they have been noticed.

Analogies of the CETONIADÆ *to the Tribes of the* COLEOPTERA.

Sub-families.	*Typical Characters.*	*Tribes.*
	1. *Typical.*	
CETONIANÆ.	Mandibles concealed.	LAMELLICORNES.
	2. *Sub-typical.*	
RUTILINÆ.	Mandibles prominent.	PREDATORES.
	3. *Aberrant.*	
MEGASOMINÆ.	Stature gigantic, feed within decayed wood; each typifying the ruminating quadrupeds.	CAPRICORNES.
MELOLONTHINÆ.	Body sub-globose, convex; legs unusually long.	MONILICORNES.
GLAPHYRINÆ.	Elytra short, thin, flexible.	MALACODERMES.

It is scarcely possible to conceive greater harmony than that which subsists between these two series. The experienced naturalist, if he wishes to detect innumerable analogies which result from this exposition, has only to compare the contents of the first circle with all those mentioned in this work, and he will find, in every instance, the same results, however differently varied. They may not, indeed, be striking, because analogies are strong or faint, according to the dissimilarity of the groups compared; but each comparison will throw light upon the other: we may trace, for instance, the convex body of the *Melolonthinæ* through their corresponding type of annulose and vertebrate animals, down to tortoises, or chelonian reptiles, until we arrive at the perfectly cylindrical body of the intestinal worm; extended, as the latter is, to such a disproportionate length. By this disposition, also, of the *thalerophagous* groups, we at once perceive that Nature really has intended the *Glaphyrinæ* to represent the *Hymenoptera;* and the *Ce-*

tonianæ to feed upon the same parts of a plant as nourish the *Lepidoptera*,—namely, the flower. And here another obscure glimpse of interminable relations opens upon us; for as these two latter groups are pre-eminently typical, so do they draw nourishment from the *most perfect* part of a plant, which every one knows to be its flowers. The unusual length of limb, again, possessed by the chafers, and (if the fact be true) their partiality for sandy countries, is at once explained by their being the grallatorial beetles,—that is, by their representing the order of wading birds (*Grallatores*), which course the sands of all maritime countries, and sometimes congregate, like these beetles, in migratory hordes of countless numbers: both groups are remarkably deficient in bright colouring, for both assume the tint of the naked ground. But we must pause; for, although analogies equally beautiful crowd upon the mind, we are limited to a mere sketch of this inviting subject. Let it be remembered, however, that "natural groups will stand any test;" and that, unless those of the insect world will bear a comparison with such as belong to all other animals, we may be satisfied that there is, in one or the other, some great error to be detected.

(194.) We must now turn to the other great division of the lamellicorn beetles,—the *Scarabæidæ*, or the *Petalocera saprophaga* of MacLeay. The first or most pervading character which strikes the general observer, on looking to this assemblage, is the thick and ungraceful form they possess: this, joined to their dark and sombre hue, and the repulsive aspect which many of them possess, give them, altogether, a most uninviting appearance. Their manners and habits are quite in unison with their general aspect: instead of sporting on flowers, living upon pure and uncorrupted food, and enjoying the brightness of day, the whole of these insects live only upon the ground, where they seek out the decayed and corrupting remains of vegetables, more especially the excrement of herbivorous animals, in which disgusting food they seem to revel with the greatest delight; within this, or in little subterranean caves immediately beneath, which they excavate with their fore-feet, do these impure creatures pass the day, — only quitting their retreats to fly abroad after the sun has run its course, and the night has begun. These nocturnal habits, however, are not universal; for some, as the true SCARABÆINÆ of warm countries, and the *Aphodinæ* of this country, may be seen abroad in the heat of the day; but they are always in search of the same disgusting food,—shunning the sweets of Flora, as if they were, to them, poison. A few, however, prefer nourishment of a less offensive nature: the large *Dynastinæ* subsist entirely upon rotten wood, and take up their stations in the hollows of decayed trees, where both the larva and perfect insect may be found. But these are only slight modifications of the same habits; for the whole family live entirely upon decayed vegetable matter, in different stages of decomposition: and although some few, as certain *Anthophagi*, and several of the foreign *Scarabæinæ*, are partially ornamented with metallic colours, yet the general hue of the whole of these insects is different shades of black, and dark brown.

(195.) The structure of these insects is as peculiar as their general appearance and habits. The body is short, thick, and clumsy; the thorax so large, as generally to be of the same size; while the legs are much more spinous than those of the *Cetoniadæ*. Their great characteristic, however, is to be found in the construction of their feet. As the legs of the *Cetoniadæ* are so admirably adapted for clinging to plants and branches, so are those of the *Scarabæidæ* for walking upon the ground; although their motion and progress, on such occasions, is neither graceful nor active. The *tarsi* are universally very short and slender, — often, indeed, nearly obsolete; and although, in some of the divisions, the five joints are of the same shape, and even present much of the same relative proportion to each other as those of the *Cetoniadæ*, yet they are, collectively, invariably shorter than the shank of the leg, or that part which forms the middle joint. The different modifications of the tarsi will be found, also, of the greatest use in determining the different sub-families: let the entomologist, for instance, examine those of the true *Scarabæus* and of the common *Geotrupes stercorarius*, whose drowsy hum is so familiar to us in summer; he will then perceive that, while the first exhibits the greatest possible deviation from the *Cetoniadæ*, by having the first joint of the tarsus larger than any of the others, and the last hardly thicker than that which precedes it, the latter has a miniature resemblance to the long thickened claw joint so prevalent among the floral beetles, with this difference, however, that the preceding joints gradually become smaller from the first, as in all this family, and are defended by strong bristles, which are, no doubt, highly useful in assisting the animal to walk upon the ground. In proportion, also, as we leave this family, and approach the confines of the last, we observe a gradual approximation in the structure of their tarsi, until, upon reaching the bulky *Dynastinæ*, the two families insensibly blend into each other; so that much more refined characters must be used to determine their respective limits, than has yet been employed by any author who has written upon the lamellicorn genera.

(196.) On looking to the anatomical construction of the *Scarabæidæ*, we find they exhibit, in the nature of their jaws, the same primary divisions as are observable in the last family. In one (the *Cetoniadæ*), these organs, from being membranaceous, plainly show that the insects live upon juices, and, "as it were, by licking their food;" while the second, composed of insects which have corneous or crustaceous maxillæ, live on more solid species of food, and by mastication.* But without entering further into these analogies, we must at once proceed to enumerate the five leading divisions, or, as we consider them, sub-families, into which the learned author, just quoted, has divided the whole: these are—1. the *Scarabæinæ;* 2. the *Geotrupinæ;* 3. the *Dynastinæ;* 4. the *Troginæ;* and, 5. the *Aphodiinæ.*

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* Hor. Ent., 27.

(197.) The *Scarabæinæ*, or true scarabs*, are by far the most numerous, and, consequently, the most varied of the whole: in this respect they resemble not only their prototypes, the *Cetonianæ*, but nearly all other pre-eminently typical groups in the animal kingdom. Few, however, are found in Britain; and these, chiefly belonging to the genus *Onthophagus*, are of a small size: the rest are chiefly inhabitants of tropical, or, at least, of warm latitudes. According to the arrangement we are now chiefly following, the insects placed in this division have all membranaceous mandibles, which are fimbriated at their tip and on their inner side: the mouth is also invariably concealed beneath the *clypeus*, or shield, which advances in front of the head; and this, according to MacLeay, is the most constant character, as well as the most certain, by which the true scarabs may be distinguished from such genera of the next division as make the nearest approach to them. This latter character, therefore, is confessedly of more importance than the first, even in a scientific point of view; while it is, also, much more adapted for general use. The form of these insects will also materially aid us in distinguishing them: the body is particularly short in comparison to the thorax; it is also greatly depressed in the majority, although very convex in the genus *Copris*, which, from other circumstances, does not appear to be typical: the head is large, owing to the great developement of the *clypeus*, or shield, which projects all round it—often so much as to conceal the largest portion of the eyes and the antennæ: the different modifications of this part of the insect are all very remarkable, and deserve much more attention than they have yet received. In the typical genus, *Scarabæus*, the clypeus is semicircular in front, but deeply marked by obtuse tooth-like divisions, as in *S. Sacer*, varying in number according to the sub-genera, and even, sometimes, in the species. None of these, however, have any horns or erect spines, either upon the head or thorax; and a very few, like the *Ateuchus Egyptiorum*, are more or less glossed with metallic green. In *Copris*, however, the clypeus, although slightly emarginate or notched in front, has the margin otherwise undivided: but in *Onthophagus* it is almost always entire, and even sometimes pointed, as in the well-known *O. Taurus*,—a species which is a rare example in this country of this genus possessing well-defined horns upon the head.

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* See the relative rank of these groups in *Classification of Animals*, p. 273.

(198.) The *tarsi* of this family are very remarkable; and although little, if any, attention has yet been paid to these organs among the *Lamellicornes*, we feel persuaded they will furnish some of the strongest characters for indicating natural groups. We have already described the hinder tarsus of the typical genus, *Scarabæus*; and this will also suffice for that of *Copris*; but the anterior tarsi of the former are obsolete, while those of the latter, although small, are sufficiently obvious: there is scarcely one natural group, in short, which does not present some modification of the joints, either in shape or proportion, by which such group could be characterised. We do not mean to intimate, by this, an approval of the tarsal system, as it is overstrained by some entomologists; still less that these characters should take precedence, in all cases, of others. But, as the organs of prehension or of motion are confessedly among those of paramount importance among vertebrate animals, so do we conceive they may be, from the nature of the case, equally so in the annulose groups; and experience has confirmed this supposition. There requires no examination or dissection of the organs of manducation, to determine the two great divisions of the typical lamellicorn beetles; their feet at once determines the point to the most inexperienced observer; and, although these characters have actually been overlooked, yet they are the only ones of a tangible nature which can establish the differences in question.

(199.) This division comprises considerably the greatest number of forms exhibited by the circle of which they constitute a chief component. We have here the depressed *Scarabæus*, *Gymnopleurus*, and *Pachysoma*,—the latter resembling a couple of conjoined semicircles, and further curious from its very hairy legs. Then we have, next, the very convex *Circellium*, *Chalconotus*, *Coprobis*, *Copris*, and *Phanæus*, the last distinguished for the armature of their head and thorax; the latter usually retuse in front: we have then the irregularly gibbous *Sisyphus* and *Hyboma*,—which form merges in the flatter *Onthophagus* and *Coprobices*; and this passes through the more elongated *Onites* and *Oniticellus*, which terminates in the elongate, parallel, and completely flattened surface of *Eurysternus*. There is as much diversity in the proportion and structure of the legs of these insects, as in their general form. Thus, the convex forms are the most essentially fossorial in the structure of these limbs, —exhibited in the dilatation, concavo-convex, and externally considerably denticulated edge of their anterior tibiæ; and in all the legs of these, there is a greater uniformity of size and length. The depressed series makes an easy transition in the comparative slenderness of these limbs, and the increasing length of the posterior pair to the gibbous group, where the latter are very lengthy and considerably curved. In the *Onthophagi* and their allies, we find a great resemblance to the pre-eminently fossorial structure; but in *Eurysternus* we have a third type of structure, where the intermediate legs are the longest. Considering the substances that these creatures frequent, and whence they have been termed the "scavengers of nature," we, of course, expect to see obscurity of tint prevail; but when we observe the metallic brilliancy of many of the *Coprobii*, *Onthophagi*, and *Phanæi*, the splendour of whose colours will frequently rival any throughout the *Coleoptera*, we are tempted to exclaim at the caprice of Nature, which has clothed the inhabitants of such nauseous substances in such gay habiliments. It is a striking circumstance, and exhibits an anomalous condition of many of this group as compared with the majority of the *Coleoptera*, that their males are dispossessed of anterior tarsi; but this deficiency is supplied by an elongation of the tibia, which is curved at its extremity. The object of the elongation of the posterior legs in these insects is deduced from the observation of their habits; whence we find that they use them to propel the balls of dung, wherein they have deposited their egg, to the receptacle they have formed for it; and they thus propel it, walking backwards. Perty*, whose notice of the habits of these insects is the most complete we possess, informs us, that some species of *Scarabæus* frequent ants' nests during the winter. *Hyboma* (if he be right in the genus, which is somewhat doubtful) frequents dung, is not fossorial, and rarely flies. The *Coprobii* are found in fallen leaves, dung, and also frequenting the exuding sap of wounded trees. The *Eurysterni* are also not burrowers, but are active on the wing during the day. The conformity of habit in genera is confirmed by the intertropical *Coprides* burrowing like our native species. The *Phanæi* are not very different in habits to *Copris*, and fly during evening with a loud noise and considerable velocity: they are extremely abundant, even the largest species, the *P. Principalis*, which is more than two inches long, and an inch and a half broad. It must present an extraordinary appearance to an European collector, to witness, for the first time, the air and the earth, in intertropical regions, teeming with their hosts of insects, and these large *Coprophagi* sweeping through the sky with the velocity we observe in our native species. Many of them are diurnal flyers, but the majority, as here, are crepuscular, and boom around, during dusk, with their sonorous hum. [W. E. Sh.]

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* Delectus Animalium Articulat. Pref. p. 7. &c.

(200.) The next division is composed of the *Geotrupinæ*, or drone scarabs. "Concisely describing these insects," observes Mr. MacLeay, "it may be said, that they differ from the last by their corneous mandibles, and from the *Dynastinæ* by their exserted labrum" "But such characters," as he truly adds, "like all others, are subject to an infinity of shades, and may even altogether disappear in some insects of this family hereafter to be discovered. They are coprophagous, or boletophagous.* Some extreme genera. however, live on roots, and may even be considered lignivorous." Most, if not all, the typical species, which are comparatively few, inhabit temperate latitudes; while such as are here considered "extreme," or, rather, aberrant, genera, are restricted to warm or tropical climates.†

(201.) The common *Scarabæus stercorarius* of Linnæus, so abundant in this country, is one of the best examples we can adduce of this division. In its short convex body, and, indeed, in general appearance, no less than manner, it presents a strong resemblance to the genus *Copris* among the *Scarabæinæ;* but the position of the hinder legs is different; the head is smaller; and, from not being furnished with a dilated shield, the protrusion of the mandibles, which are very strong, horny, and arcuated at their tips, is rendered very evident; the labium is also exserted, or, as it were, pushed out,—in which respect they strikingly differ from the typical scarabs. The tarsi furnish another important character; although considerably shorter than the shank, their structure shows an evident approach to what is seen in the floral beetles, or the *Cetonidæ:* the claw joint is the longest, and even exceeds the first; the others gradually diminishing downwards: the joints, moreover, are cylindrical, and not, as in the former division, compressed.

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* That is, feeding either upon dung or decayed *fungi.*

† Hor. Ent., p. 52.

Yet, with all these incipient indications of a prehensile foot, these insects are invariably found upon the ground, —where, however, they walk with much more difficulty than the typical *Scarabæinæ.* The sub-genus *Elephastomus*, with its incurved snout, is one of the most singular insects in this assemblage.

(202.) Many of the observations that we have made upon the habits of the *Scarabæinæ* at page 227., will be found to attach to the present group. These insects, however, are never richly metallic; and they are more exclusively fossorial. They differ less in form, but more in habits, from each other, than that group; for *Lethrus* feeds upon the eyes of the vine, and where they abound in the vicinity of vineyards, they do considerable mischief. They are more essentially social than any of the *Petalocera*, for they live in pairs in deep burrows in the ground. Fischer tells us that they are very jealous, and extremely pugnacious; and their structure would at once convince us that such collision must be very severe, —the mandibles of the male having beneath an enormous process, nearly or quite as large as the organ itself. There are but few genera belonging to this group, and their species also are not numerous; and these genera have also a more limited geographical range than those of the adjacent families. Thus, *Elephastomus* is confined to New Holland; *Orphnus*, to Africa and India; *Geotrupes*, to Europe and America; *Lethrus* is wholly European, but *Bolboceras* ranges over the entire world. [W. E. Sh.]

(203.) The *Dynastinæ*[*] evidently follow the *Geotrupinæ* in a natural series, through the medium of such forms as have their bodies rather longer than the *Geotrupinæ*, but shorter than that of *Oryctes nasicornis*. This latter we shall, for the present, view as the type, not because we really believe it to be such, but because it is the only species of whose habits and economy, as yet, any thing decisive is known. Although not found in Britain, it appears by no means uncommon in various parts of the Continent. De Geer once discovered a considerable number of them, both in the larva and perfect state, in a heap of rich vegetable mould; and other writers mention its being found in half-rotten tanpits. This is sufficient evidence that this insect feeds upon decayed wood; and it therefore follows, analogically, that all others, having the same general structure, do the same. The tips of the jaws are rather membranaceous than corneous, and being unarmed with the teeth of the true *Dynastinæ*, clearly show that they are employed upon a much softer species of food: in other words, we are brought to the conviction that the *Dynastinæ* — in unison with the predominant character of all the other *Scarabæidæ* — feed upon decayed wood; and that the *Megasominæ* subsist habitually upon that which is either in a living state, or but just beginning to decay: thus are the two grand and leading characters preserved; and consumers are provided, in these groups, for every stage of vegetable existence, — from the flowers, on which alone the *Cetonianæ* exist, down to the excrement of herbivorous animals, in which the *Scarabæinæ* delight to revel.

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[*] Here separated from the *Megasominæ*, but confounded with them by former writers.

(204.) But without looking merely to those characters upon which so much stress has been laid, — namely, the *internal* parts of the mouth, — let us see how far the separation here made of the *Dynastidæ* of Mr. MacLeay, into two sub-families, is borne out by the structure of their respective tarsi. We have already seen in what manner the two great divisions of terrestrial and arboreal scarabs are thus naturally characterised by their feet; and this becomes apparent even at the point of their junction. The posterior tarsi of the *Oryctes nasicornis* may be thus described: they are decidedly shorter than the shank; almost as slender, in proportion to the thickness of the legs, as those of the *Geotrupinæ;* the first, or basal joint, is much the largest of the four, — the three others being considerably graduated; the last, or claw joint, is equal in length to the two preceding; and they are all as well covered with bristles at their articulations, as those of the terrestrial *Geotrupinæ.* There is, in fact, so little difference in degree between the posterior tarsus of *O. nasicornis* and *G. stercorarius*, that it is quite obvious they both deserve to be considered terrestrial scarabs, although separated into distinct sub-families by the other parts of their organisation: the claw joint, indeed, of *Oryctes* is is much more developed; yet still, although longer, it is not so thick as the first tarsal joint, and, in many of the Brazilian species, it is particularly slender. We may now turn to one of the best known insects among the *Megasominæ,* — viz. the Hercules beetle (*M. Hercules*). The hinder tarsi, instead of being shorter, are very considerably longer than the shank; the basal joint, although *very* slightly thicker, is rather shorter, than the three following, which are all of the same size and length; while the claw joint is so highly developed, that it is equal in length to the three preceding ones: no hairs whatever are upon any of the joints, and the claws themselves are remarkably hooked. Now, it cannot for a moment be doubted that this gigantic insect is completely arboreal, and that its progress upon the ground would be just as slow and unnatural as that of a genuine *Scarabæus* upon a branch. We have confined the foregoing comparison to the hinder tarsi of these respective insects, not from any supposition that they are more important than the others, but simply because we judge it unnecessary to enter into similar details respecting the remainder: in point of fact, the same relative proportions in the joints will be found in all the other legs; premising, however, that the anterior claw joint in this, and nearly all the arboreal *Megasominæ,* is much more developed, in proportion, than that of the terrestrial *Dynastinæ.*

(205.) From the foregoing observations, it is, therefore, evident that the *Dynastidæ* comprise two distinct natural groups of equal value, by which the terrestrial and arboreal lamellicorn beetles are united. This opinion can be established upon two distinct grounds: first, on the nature of their food, as indicated both by facts of economy and of structure; and, secondly, by their organs of locomotion. In the latter, indeed, no less than in the former, there are numerous modifications; and these will, doubtless, indicate some of the most natural of the minor groups, or sub-genera; but we have yet seen no insects which did not come under one or other of these groups, or which did not fall into the natural series by which they are connected to others. We have had frequent occasion, in our progress through the vertebrate animals, to show how much the peculiarity of *colour* enters into the composition of natural groups. The same remarks are applicable, as every experienced entomologist is aware, to insects. In the present case, it may be observed, that the whole of the genuine *Dynastinæ* are either deep glossy black, or dark brown; and although very many of the *Megasominæ*, as *D. Actæon*, &c., are of the same dark colours, yet the majority have the elytra of a livid green, as if they had been coloured with the weakened sap of the decaying trees upon which the insects themselves chiefly fed. This, of course, is mere conjecture, yet it is by no means either impossible or improbable.

(206.) The genera we consider the most typical of our *Dynastinæ*, are *Oryctes*, *Phileurus*, *Hoplites* (*Enema* Kirby), and *Archon*. This, consequently, is also a limited group; which, however, is not yet thoroughly analysed as respects our views concerning it. All that we know of the habits of the insects contained in it, we have already stated. The forms are more elongate than any of the preceding, and also sometimes considerably depressed, as in *Phileurus*, *Enema*, and *Heteronychus*. We do not expect that any of them, in their perfect state, are sessorial, although they have all the requisite structure. They are considerably dispersed over the world; although *Phileurus* and *Enema* are exclusively American; *Cryptodon*, African, as well as *Heteronychus*.

(207.) The *Troginæ* are the next great division among the terrestrial scarabs. They have been compared by Mr. MacLeay, and very justly, to the genus *Hister:* both appear to be fond of cadaverous matter; both "have their head sunk in the thorax in a very peculiar manner; and both have the curious habit, when alarmed, of counterfeiting death, by applying their feet and antennæ close to the body, and ceasing all motion until their fear may have subsided." We may add to these analogies, the Linnæan genera *Ptinus, Dermestes, Cassida, Curculio, Elater, Buprestis,* and several others; all of which, in their own proper circles, are types of the MONILICORNES. They are also related to the *Melolonthinæ,* not only by their very convex body and obtuse head, but by the very same habit of counterfeiting death, which the *Melolonthinæ* possess in a very high degree.* Here, however, the similarity ceases. The *Troginæ,* in comparison to the other divisions, are remarkably few, and but very little diversified either in colour or in form: they are all small insects; and possess the peculiarity, almost unknown in others of this family, of having the elytra deeply and thickly marked by excavated hollows. Some of them are apterous,—another point of analogy they bear to several of the monilicorn types; while one (*Trox luridus* Fab.) is said to have been found in rotten wood.† The external resemblance between these insects and some of the small *Melolonthinæ,* such as *Serica,* &c., is well worthy of attention. The *Trogidæ,* at first sight, seem to be a much more isolated group among the saprophagous *Petalocera,* than what we suspect they really are. Among the smaller types, or sub-genera, of the *Dynastinæ,* there are several insects which appear to form a very gradual passage between the two, although we have not yet been able to discover the point of junction: this, however, will not in the least militate against the situation that has been assigned them in this circle; for it is quite obvious they can hold no other station.

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* The common cockchafer will continue this deception even if thrown up in the air; instead of spreading its wings, it will fall to the ground as if it were really dead.

† Hor. Ent., p. 63.

(208.) The *Aphodiinæ* form the last sub-family: they are the least in size of the whole; and, although not very few in point of numbers, the variations in their structure are comparatively slight: they differ anatomically from the *Scarabæinæ*, in having short dilated coriaceous mandibles, and the pairs of feet at equal distances from each other. They are also sufficiently separated from the *Troginæ*, by having their labrum concealed under the clypeus; and by their mandibles being thin, compressed, and scarcely to be called corneous.* The scutellum is always distinct; and the head and thorax are almost invariably smooth. The species swarm in temperate climates, and are particularly common in our fields during the spring and summer months,—hovering over, and very soon burying themselves, in the dung of cattle, to which they give a decided preference. Their geographic range is comparatively limited. Mr. MacLeay was unacquainted with any from the Australian range; and we only met with a very few minute species in Tropical America; while at the Cape of Good Hope, however, where large herbivorous animals abound, they are not uncommon. It appears that, although the majority are coprophagous, yet that many live entirely upon putrid marine plants: thus the former open a passage to the aberrant *Scarabæinæ*, with which we began our survey, while the latter, by frequenting sandy situations, prefer the same localities as the majority of the *Troginæ*.

(209.) The two preceding families—the *Troginæ* and the *Aphodiinæ*—are the most limited of the whole circle. We have already sufficiently treated, above, upon their natural history; and we will only further remark, that we consider the *Troginæ*, within themselves, the most anomalous family of all, as it is scarcely possible to conceive a proximate affinity between such genera as *Acanthocerus* and *Trox*. The former, like *Agathidium*, has the faculty of rolling itself up into a complete ball, —indeed, so much so, that one we received from the Brazils was transpierced through the elytra, near the scutellum, and again through the head. It is otherwise remarkable for the extremely dilated expansion of its tibiæ. which form thin plates, that fold up within a cavity beneath the body; and thus, when the insect is rolled, there is not the slightest vestige of these limbs to be seen for the tarsi fold back upon the tibiæ. The pentamerous tarsi, and lamellated structure of the apex of the antennæ, are all that seems to associate it here. If this be admitted, we see no reason why one of the *Bostrichidæ*,—the *Phloeotribus Oleæ*,—which has likewise lamellated antennæ, should not come into the lamellicorn circle. The habits of *Acanthocerus*, also, are to frequent flowers, and not carrion, or putrescent substances, like all its present associates. *Trox*, to us, seems to have itself a strong relation, perhaps of affinity— if habits and habit can show this—with *Opatrum* amongst Latreille's *Heteromera*. *Trox* is of universal dissemination; *Acanthocerus* is wholly American; and it is difficult to say what other insects should enter the group. [W. E. Sh.]

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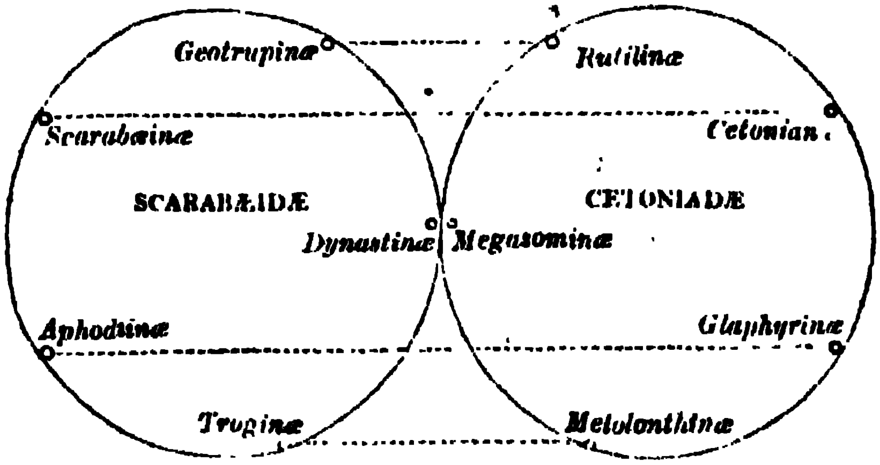
* Hor. Ent., p. 58.

(210.) In the *Aphodiinæ*, we have greater uniformity of general habit, as also of specific habits; and this, although a limited group in forms, is, especially in its types, very abundant in species; for *Aphodius* numbers as many as any genus, except *Onthophagus*, within the lamellicorn circles: it is also found every where excepting in New Holland; and the only departure from the habits of the family is in *Ægialia*, a small genus, consisting of but two species,—one European and one American,—the European occurring in Great Britain, upon our sandy coasts, where possibly it feeds upon putrescent fish, or the rejectamenta of the sea. The relative proportions of these five groups differ greatly from the parallel series of thalerophagous *Petalocera*, and would stand thus in round numbers. *Scarabæinæ* precede all in genera, as well as species, and overwhelm them with its numbers. In genera, the *Geotrupinæ* follow them. The *Dynastinæ* and *Aphodiinæ* are about equal; and the *Troginæ* are the lowest in the scale. In species, their relative proportions are, *Scarabæinæ*, as 29; the *Aphodiinæ*, as 7; the *Geotrupinæ*, as 3; and the *Troginæ* and *Dynastinæ*, as 2 each. [W. E. Sh.]

(211.) Having now detailed the chief peculiarities of the five great divisions in each of the typical circles of this tribe, we may proceed to verify their accuracy; first tracing the mutual analogies they present to each other, and then illustrating the subject further by comparing them with other and more dissimilar groups. The annexed diagram will exhibit, in one view, the disposition we have now made of the whole.



This diagram at once exhibits both the affinities and the analogies of the two typical divisions of the *Lamellicornes*. The first, or the *Scarabæidæ*, are the *Saprophaga* of MacLeay; the second, or the *Cetoniidæ*, are his *Thalerophaga*. Furthermore, the entomologist will perceive that we have taken for granted eight out of the ten relations of affinity exhibited in this diagram, on the authority of the same author; so that the extent of our alteration consists in separating the *Dynastinæ* into two sub-families. The *Megasominæ* thus occupy the station assigned by Mr. MacLeay to his *Anoplognathidæ*, — a group which appears to form an aberrant portion of the *Rutilinæ*. We feel it necessary to make these observations, as we by no means are satisfied, in our own mind, that the *Cetonianæ* are so far removed from the *Megasominæ*, as they appear to be in this arrangement. These doubts are occasioned by the strong and unquestionable relationship between the gigantic *Dynastinæ* of the New World, and their prototypes in the genus *Goliatha*, on the opposite coast of Western Africa. The question, then, simply resolves itself into this:—Is the obvious relation between these groups one of affinity, or of very strong analogy? This important point can only be determined by a thorough analysis, not merely of the two groups in question, but also of the *Rutilinæ* and the *Glaphyrinæ*; for it is yet by no means clear that *Goliatha* may not be really within the circle of the latter. At all events, it is perfectly obvious, that these gigantic insects represent that type which we shall term in this, as in former volumes, the *Rasorial*. This will be equally true, into whatever circle they may ultimately be found to enter. Their extreme rarity, and very high price (for they are the most valuable, in a commercial point of view, of all insects), render it impossible to procure a series of the species for thorough examination.* It is clear, however, to us, that the *Goliathæ* of Brazil are much nearer related to the *Glaphyrinæ*, through the medium of *Trichius*, than to these African types; although nothing, at present, can be stated with safety on the true nature of all these relations.

(212.) We may revert to the foregoing diagram, solely with a view to illustrate the analogies, — there expressed by dotted lines, and founded on the following characters: —

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* One of these sold for 11*l*. 10*s*. 6*d*. at the sale of Drury's fine collection of insects in 1805. A beautiful figure was published by Martyn of this grand insect, under the name of *Scarabæus gigas*. Others have been more recently found on the western coast of Africa; but they are so much prized, that we have heard of 30*l*. having been offered and refused for a single specimen,—the proprietor demanding 50*l*. It was subsequently sold, as I understood, for 10*l*.

Analogies of the SCARABÆIDÆ *and the* CETONIIDÆ.

Sub-families of *Scarabæidæ.*	*Analogical Characters.*	Sub-families of *Cetoniidæ.*
GEOTRUPINÆ.	Mandibles porrect, horny.	RUTILINÆ.
SCARABÆINÆ.	Mandibles membranaceous.	CETONIANÆ.
APHODINÆ.	Maxillary process membranaceous.	GLAPHYRINÆ.
TROGINÆ.	Mandibles acute; head short, obtuse, smooth; body very convex.	MELOLONTHINÆ.
DYNASTINÆ	Mandibles obtuse; head and thorax of the male armed with horn-like processes.	MEGA

It will thus be seen, that if the difference in their food, and the opposite construction of their tarsi, are not considered, these ten groups would, in the construction of their mouth, be almost exactly alike. It has been stated, as an additional analogy between the *Troginæ* and the *Melolonthinæ*, that they both frequent, in preference, sandy soils: we must not, however, attach too much importance to this alleged fact; for we have not found that our common chafer is more abundant in such tracts, than in others; and if the remark were general, Africa, the most sandy region in the globe, should therefore be the metropolis of this race,—which it certainly is not.

(213.) In further proof that the *Megasominæ* are naturally allied to the *Rutilinæ* by the nature of their maxillæ, and their sub-porrect mandibles, the opinion of Latreille may be quoted; for this celebrated entomologist has considered these relations as establishing an affinity between the two groups. This remark is in complete unison with the disposition we have here made; for, by removing the *Dynastinæ* into the circle of the *Cetoniadæ*, and reducing *Anoplognathus* into a component part of the *Rutilinæ*, there is no intervening group to disturb the evident connection.

(214.) Having so fully illustrated the analogies of the five primary divisions of the *Cetoniadæ*, by comparing them with the higher orders of insects, and the more remote groups of the vertebrate circle, we need not repeat the same details in this place. If the above comparison between the *Cetoniadæ* and the *Scarabæidæ* is really natural, it follows that the latter possess precisely the same analogies to all other groups, as do the former. Hence it is only necessary, in this place, to assemble the names of the different groups which have been thus compared, that the eye may at once embrace the whole.

Analogies of the TYPICAL LAMELLICORNES *with other Groups.*

Sub-families of the CETONIADÆ.	Sub-families of the SCARABÆIDÆ.	Tribes of the *Coleoptera*.	Orders of the *Ptilota*.	Tribes of QUADRUPEDS.
Cetonianæ.	*Scarabæinæ.*	LAMELLICORNES.	LEPIDOPTERA.	*Quadrumana.*
Rutilinæ.	*Geotrupinæ.*	PREDATORES.	HEMIPTERA.	*Feræ.*
Megasominæ.	*Dynastinæ.*	CAPRICORNES.	HYMENOPTERA.	*Ungulata.*
Melolonthinæ.	*Troginæ.*	MONILICORNES.	COLEOPTERA.	*Glires.*
Glaphyrinæ.	*Aphodinæ.*	MALACODERMES.	NEUROPTERA.	*Ceta.*

It thus appears that the *Cetonianæ* pre-eminently represent the most typical of the coleopterous tribes, the most perfect of the orders of winged insects, and the most highly organised of vertebrate animals: the *Rutilinæ*, by their large jaws, find their representatives not only in the *Geotrupinæ*, but in the voracious *Cicindelidæ*, the predatorial *Hemiptera*, and the beasts of prey: the gigantic *Dynastinæ* and *Megasominæ* stand as prototypes of the great capricorn beetles, and the bulky ruminating quadrupeds. The most striking analogies are merely glanced at, that the philosophic entomologist may elaborate innumerable others which result from this table.

(215.) On the three aberrant families of this tribe,—the *Lucanidæ*, the *Buprestidæ*, and the *Hydrophilidæ*,—our notices must be brief: they are greatly inferior in point of numbers to the typical groups, and no attempt has yet been made towards determining their circular arrangement. The LUCANIDÆ, or stag beetles, evidently follow next in the series, from which they are to be distinguished by several characters: the tarsi are invariably five-jointed, — of that structure, developed in a greater or less degree, which belongs to the *Cetoniadæ:* the antennæ are of the lamelliform structure, but are more developed than in the two former families, — that is, in regard to their length; and the acute angle which distinguishes the typical genera, of which the common stag beetle of Europe is a familiar example: the tarsi are particularly lengthened in the types, but very short in the aberrant genera. The whole appear to be herbivorous or lignivorous — that is to say, feeding on vegetable substances either in a living or decayed state. Several genera may be safely included in this family, however, which depart very considerably from most of these characters. Their large exserted jaws, and general affinity to others of a more decided character, fully justify us in bringing them in here. The excessive developement of the jaws, indeed, constitute the most typical, or, at least, the most obvious, character of the *Lucanidæ;* and yet, in the aberrant groups, these organs are not very prominent. The greater part seem to be naturally arranged in the following sub-families: — The *Lucaninæ* and the *Lampriminæ* are obviously the two typical; while the genera *Hister*, *Ptinus*, and probably that of *Byrrhus*, seem to lay the foundation of the three aberrant sub-families: around each of these may be assembled several other modern genera of minute lignivorous insects, now scattered as small families, in our systems, under different heads. However this may be, it is perfectly clear that, in the *Lucaninæ*, we have that point of junction between the typical pentamerous insects of this family, and those which, by their frequently dilated tarsi, become analogous, and pass into the *Tetramera*. The *Lucaninæ*, also, are highly interesting in another point of view: they form, beyond doubt, the true passage between the lamellicorn and the capricorn tribes,—an affinity, indeed, that has been more than once remarked by several writers, but which has never yet been acted upon, that we are aware of, in any of the modern systems. The very change of food, of structure, and consequently of habit, from those families which subsist on living and those which delight in dead trees, may all be traced within this circle; so that in several of the smaller groups we have the jaws of a *Lucanus*, with the antennæ and the tarsi of a capricorn beetle. There is a strong analogy between the two typical groups of this family, and those of the scarabs. In the vivid and highly beautiful colours of the *Lampriminæ*, we have a symbolical representation of the *Cetoniadæ*, while the dark and sombre *Lucaninæ* correspond in the same manner to the *Scarabæidæ*. The analogy, again, of this family to the *Megasomidæ*, the *Dynastinæ*, and all the rasorial types, is too obvious to be dwelt upon: and may, indeed, be gathered both from their common name of stag beetles, as representing the horned quadrupeds, as well as by their habit of licking up their food, just as an ox licks the grass.

(216.) The *Lucanidæ*, as we above consider them, comprise a group of insects of much greater diversification of structure and habits than either of the typical circles that we have just gone through. The genuine *Lucanidæ* constitute our two first families; and of these, the first contains the most normal insects. The variety of shape in these is very considerable. From nearly the parallelopipedal form of *Lucanus*, *Dorcus*, and *Platycerus*, it becomes almost hemispherical, as in *Colophon*; or cylindrical, as in *Nigidius*, *Sinodendron*, *Figulus*, *Cardanus*, and particularly so in *Chiron*; which latter takes a form and fossorial appearance which seems to point in the direction of *Scarites*, whilst *Sinodendron* as distinctly points towards the *Bostrichidæ*. The family terminates with the elongate, linear, and depressed *Passalus* and *Paxillus*. In size, the *Lucanidæ*, especially *Lucanus* itself, is very imposing; this is most conspicuous in some of the Indian species, in which they are sometimes three inches long. The *Passalus tridens*, also, from Java, is two inches and a half long. The majority, however, are of moderate or even small dimensions. We have already said that the distinguishing feature of the group is the great developement of their mandibles, which are frequently angulated or toothed in a remarkable manner: in the present family, this occurs most conspicuously in *Lucanus* itself; in which genus, and in *Dorcus*, if they do not curve downwards, they are horizontal; but their most characteristic form, or that which is most prevalent, is to curve upwards. We also find their head frequently sculptured or tuberculated in a peculiar manner; but it is rarely that we observe this feature occurring in the thorax: in the male *Sinodendron*, however, it is particularly retuse. Very few of the present family exhibit a metallic or coloured clothing, but we still observe it in *Platycerus*. Their natural history is very unvaried: we have above recorded their habits, which are possibly incidental to both the typical families. *Passalus* and its affinities are said to commit great devastation in sugar plantations in South America and the West Indies. The larvæ are formed, as far as they are accurately known, upon the usual lamelliform type. [W. E. Sh.]

(217.) The second group are all more or less distinguished for their metallic splendour, which is most brilliant in *Lamprima* itself, and in *Chiasognathus*, a superb insect both for size and colour, and in which the mandibles of the tribe attain their greatest developement; they are, however, slender, and, as well as in *Pholidotus*, curve downwards: they have, beneath, a moderately long horn at their base. There is less diversity in the geographical distribution of the present family, than in the preceding. Thus, *Lamprima* and *Rhyssonotus* are confined to the Australian group, where the former sometimes appear in excessive profusion, and seems to replace there the occurrence of *Lucanus*. *Pholidotus* is South American, where it has a wider range than the equally American *Chiasognathus*, which appears to be restricted to the little island of Chiloe, on the western coast of Northern Patagonia. In the former family, the majority of the genera have a wide diffusion: although *Colophon* is exclusively African, and *Syndesus* Australian: but the island of Java exhibits the largest forms throughout the *Lucanidæ*: with this exception only, we observe in these insects the reverse of what we have noticed in the other *Lamellicornes*, — namely, that intertropical countries produce comparatively the smallest species. [W. E. Sh.]

(218.) The *Histeridæ*, the third family of this group, are more exclusively saprophagous than the preceding insects. They present equally curious modifications of general form. Thus, in *Hister*, the typical structure is quadrate and almost cubical: the elytra are always shorter than the abdomen in *Hololepta*, and *Phylloma* is excessively flattened; whence, probably, these insects live beneath the bark of trees: but the most remarkable form in the family is that of *Trypanæus*, which is completely cylindrical, and which as distinctly, perhaps, indicates a remote affinity again with the *Bostrichidæ*, and such genera of the *Lucanidæ* as *Sinodendron* and *Chiron*, as *Onthophilus* does a proximate one to the *Staphylinidæ*, through *Micropeplus*; if, however, the latter genus be not more correctly in its place in the present family. Their generic separation has been founded upon the mode of insertion of their antennæ, conjunctively with the reflection of their tarsi, and the channel receiving them; and the form of the prosternum; and the most satisfactory specific diagnostics are deduced from the sculpture of their integument. Their geographical distribution is very wide: *Trypanæus* is, however, Brazilian; and *Abræus* European. Being still uncertain as to what exactly constitute the other families of the group of the *Lucanidæ*, we shall leave them until analysis shall have satisfactorily ascertained the insects that fill up the temporary chasm. [W. E. Sh.]

(219.) The *Buprestidæ* form the most aberrant family of the *Lamellicornes*, and, consequently, possess the fewest of the typical characters. Their external aspect is sufficient, at once, to prevent their being confounded with any other group: it is, in fact, so peculiar, that none but an entomologist would detect their affinity to the floral beetles. The body is remarkably long, and, generally, very narrow behind; while the head and thorax are short, — the former being remarkably obtuse and broad. The tarsi have, generally, five distinct joints; but, then, they are often so dilated, as to appear, at first sight, similar to those of the *Curculionidæ* and other tetramerous genera: in some of the African types of *Buprestis*, there appear to be only four tarsal joints; the fifth, or claw joint, being so small as to be nearly hid under the penultimate one. In truth, however, the variations are so great in this single sub-family, that no stress can be laid on these characters, drawn from these parts only, for defining the whole. It may be a question whether the *Buprestis* or the *Elater* are the pre-eminent type of this family; for, although abundantly distinct, they are yet most intimately united. The first, however, is by far the most numerous both in species and in forms; and, as this is almost universally the case in groups pre-eminently typical, we are disposed to consider the sub-family *Buprestinæ* in this light. They are the most richly coloured, as a whole, of all the tribe. But, here, almost every indication of lamellicorn antennæ disappear: some large and fine species of *Elater*, indeed, have these organs fan-shaped, or flabelliform; but, in no case, are they angulated, as if broken, similar to the other lamellicorn families. These two typical groups present as great a diversity, in their respective colours, as the *Lucaninæ* and the *Lampriminæ*. The *Buprestinæ*, with very few exceptions, are richly glossed with metallic shades of green and blue; while the *Elaterinæ* are almost universally devoid of any bright colours. The peculiar powers of leaping, possessed by these latter insects, when laid upon their backs, is without parallel, and is known to every one: it is effected by means of a beautifully contrived spring placed between the mesothorax and the body; — and the spines on the posterior angles of the thorax have, no doubt, some connection with this faculty. The larvæ of these two groups feed upon the roots or stems of trees, and the perfect insects on the leaves and flowers of plants. More than one species of *Elater* is highly luminous, — the phosphoric light being emitted from a small whitish oval spot placed on each side of the thorax. Mr. Curtis has given a very interesting account of one of these species, which our mutual friend, Mr. Lees, brought home alive from the Bermuda Islands. Some smaller groups of minute insects enter, also, within this circle, but which we have no space to particularise.

(220.) The first, or more typical, family of this group presents us with the remarkable feature of modifications of form coincident with a certain geographical position; but which we can scarcely attribute to climatic influence exclusively—occurring as they do, in the same belt. But they must be considered in conjunction with local peculiarities and causes; for East and West, Zenith and Nadir, are convertible in their application. We must not, however, be understood to give an absolute restriction to the range of these forms, for we sometimes find them crossing each other; but they then constitute the exception, and not the rule. Thus, we have the obtuse, broad, flattened form of New Holland instanced in *Conognatha;* the convex gibbous form, narrowing behind, of India, found in *Sternocera Chrysis;* — the African hairy *Iulodis;* the attenuated Indian form of *Chrysochroa;* and the broadly dilated Silpha-like shape of Madagascar *Buprestidæ.* These beautiful insects occur all over the known world, and are eagerly sought by collectors, as elegant decorations to their cabinets. They abound, particularly, in the hottest climates; and are excessively active during the heat of the season in which they occur, taking wing promptly, and flying with great velocity and vigour.

It is a singular circumstance, that, although the affinity of the perfect insects of the present family is remarkably close to the next — the *Elateridæ*, — yet their larvæ are so different, that a system, founded upon these, would widely separate them: the larvæ of the former, as far as they are known, are apods, with greatly enlarged heads, and a tapering body; whereas the *Elaters* present two types, — both, however, possessing legs; — the one is long, slender, and completely cylindrical, exhibited in the wire worm, which is so excessively injurious to farming crops; and the next is the flattened form of the larva of *Lepidotus*. Although these insects are not usually metallic, yet instances occur, as in *Ludius fulgens* from China, and in our native *Selatosomus æneus* and *Ctenicerus pectinicornis:* they are, however, in compensation, frequently decorated with brilliant tints, particularly of a bright sanguineous hue, as we find it in the *Elater sanguineus* and *Pomonæ*; and this is often contrasted with an intense black, as in the genus *Cardiophorus*, and the remarkable Brazilian *Tomecephalus*. The distinguishing feature of the *Elateridæ* is, as we have before noticed, their power of leaping, but by a totally different apparatus to the legs: but some, standing upon the confines of the family, as *Pterotarsus* and *Lissomus*, are divested of this faculty; as is also the extremely remarkable *Chelonarium*, — if, indeed, it belongs to this group. Serrated antennæ are a characteristic; but these are frequently flabellated, as in *Tetralobus*, or beautifully bipectinated, as in *Callirhipis*. The usual form of these insects is regularly ellipsoidal; in some, however, the thorax forms a capouch over the head, thus pointing towards *Anobium* and *Apate;* and it is in the latter group we expect that *Melasis* ought most properly to be placed, - presenting, as it does, such strong affinities to *Ptilinus*. Generic separation has been effected amongst them by the lobated structure of the tarsi and the denticulations of their claws, considered in conjunction with the form of the posterior coxæ, their antennæ, and clypeus. The other families of this circle we can scarcely, at present, determine. [W. E. Sh.]

(221.) The fifth and last family of the *Lamellicornes* are the aquatic beetles, forming Latreille's *Hydrophylii*,—a name we retain, merely giving it the family termination of *idæ*. It is more than probable, also, that *Sphæridium* likewise enters in this part of the circle: the very name of the best known type, *S. Scarabæoïdes*, shows its resemblance to the typical families; while the little insects forming the genera *Elophorus*, and two or three of similar value, show the mutual connection of the semi-rapacious, and therefore typical, *Hydrophylidæ*, to the other lamellicorn families, and to the predatorial tribe which succeeds this. These water scarabs, nevertheless, are very few in number, although of a large size; they swim with facility, but not with swiftness. One of these is a common inhabitant of the ponds and fresh waters of Britain; and others, differing nothing in structure, occur within the tropics: the antennæ are clavate, and thus exhibit a good deal of the lamellicorn type; while in other respects they show a close relationship to the true *Dytiscidæ*.

(222.) As in all other groups, we also find here, in the more typical representatives, a combining character, which exhibits itself in the great elongation of the palpi, which, notwithstanding the differences in the habits of the insects themselves,—and these are great,—unite them permanently together. We find here aquatic, sub-aquatic, and terrestrial forms, each displaying those definite modifications which result from their appropriation to a distinctive peculiarity. Thus, we have the natatorial form displayed in *Hydrophilus piceus*, peculiarly suited for progression through so dense a medium; and the proof of which we shall find in its universal occurrence among the true water beetles, as we observe its analogy in the form of fishes, and man's imitation of these in the shapes of his ships and boats. The larva of the type of this genus is remarkable for being carnivorous, whereas the imago is herbivorous; and the latter, unlike the true water insects,—and which circumstance seems to remove it from that group,—besides its other peculiarities, swims by moving the posterior legs alternately, and not simultaneously. We find in this group, again, a slight metallic tinge in the colouring, as in many species of *Berosus*, and in the thorax of *Elophorus*. Their habits are exceedingly obscure; nothing is known of them beyond their habitat, although they are found extensively in this country. *Sphæridium* evinces its relationship to this group, by the under side of the body resembling the *Elophori*, and its antennæ, anterior tarsi, and palpi approaching it to *Hydrophilus*; whilst its habit of frequenting dung, and its circular form, give it a strong resemblance to *Geotrupes*, in the circle of the *Scarabæidæ*. The group likewise embraces a multitude of small genera, such as *Spercheus*, *Ochthebius*, *Hydrena*, &c., the habits of which are, evidently, greatly uniform; and we may further observe, that the intertropical species of all these genera are, apparently, always less than their more northern congeners, and in some, especially the aquatic genera, they are very numerous. It is not improbable that *Heterocerus*, *Parnus* and *Elmis* may be aberrant constituents of this group. [W. E. Sh.]

CHAP. VII.

COLEOPTERA, *continued*.

PREDATORES.

(223.) The most rapacious of all beetles are comprised in the tribe of *Predatores*, which, in the foregoing arrangement, we place as the sub-typical, or carnivorous, group of the *Coleoptera*,—a rank and station which is established by the analogy subsisting between the true water insects, — and which circumstance seems to remove it from that group, — besides its other peculiarities, swims by moving the posterior legs alternately, and not simultaneously. We find in this group, again, a slight metallic tinge in the colouring, as in many species of *Berosus*, and in the thorax of *Elophorus*. Their habits are exceedingly obscure; nothing is known of them beyond their habitat, although they are found extensively in this country. *Sphæridium* evinces its relationship to this group, by the under side of the body resembling the *Elophori*, and its antennæ, anterior tarsi, and palpi approaching it to *Hydrophilus*; whilst its habit of frequenting dung, and its circular form, give it a strong resemblance to *Geotrupes*, in the circle of the *Scarabæidæ*. The group likewise embraces a multitude of small genera, such as *Spercheus*, *Ochthebius*, *Hydrena*, &c., the habits of which are, evidently, greatly uniform; and we may further observe, that the intertropical species of all these genera are, apparently, always less than their more northern congeners, and in some, especially the aquatic genera, they are very numerous. It is not improbable that *Heterocerus*, *Parnus* and *Elmis* may be aberrant constituents of this group. [W. E. Sh.]

CHAP. VII.

COLEOPTERA, *continued.*

PREDATORES.

(223.) THE most rapacious of all beetles are comprised in the tribe of *Predatores*, which, in the foregoing arrangement, we place as the sub-typical, or carnivorous, group of the *Coleoptera*,—a rank and station which is established by the analogy subsisting between them and the rapacious tribes of quadrupeds and birds. As among the *Lamellicornes* there are none of a carnivorous nature, so in the tribe before us there are none which do not either wholly, or in part, live upon animal substances, whether in a living or a decayed state. This, therefore, is their primary distinction,—difficult, indeed, to be traced in the aberrant groups, from the great variation of their structure, but decidedly marked in the great majority, whether we regard their natural economy, or their peculiar organisation.

(224.) That this is a natural group, will be further apparent by the arrangement of MacLeay: this acute entomologist, looking to the formation of their larvæ alone, designates the genera *Carabus* and *Dytiscus* as examples of his chilopodiform type; so that, without founding our arrangement upon isolated principles, applicable only to the annulose animals, we yet see that, in this instance, it is in perfect conformity with his general views.

(225.) In order to give intelligible characters of this or any other natural group, it is necessary to look chiefly at the typical examples, where the pre-eminent characters are most developed. This remark is particularly applicable to the group before us, which, although palpable in three of its minor divisions, has not been sufficiently studied in regard to the two others. Confining our attention, therefore, to the typical predacious beetles represented by the *Cicindelidæ* and the *Carabidæ*, they may be known at once by the length of their legs, and the perfect developement of their tarsi, both of which are formed for running upon the ground; they are, in fact, eminently cursorial: the mouth is armed with strong jaws, and the antennæ are linear or setaceous. On looking to the aberrant groups, however, nearly all these external characteristics disappear. The *Dytiscidæ* or water beetles, have a large depressed body, and short thick feet,—the hinder pair being somewhat oar-shaped, and calculated for swimming; in their setaceous antennæ, they still resemble the typical forms; and although they inhabit a different element, they are equally rapacious,—subsisting only upon smaller water insects. This family, composing the aquatic division of the tribe, constitutes the true point of junction between the predacious and the lamellicorn beetles,—an affinity which entirely contradicts the supposition that the *Hydrodephagæ* MacL. is one of the "normal," or, more properly, typical groups. The very few genera of the *Dytiscidæ* here occasions an interruption in the series, which leaves much uncertainty as to the precise point of junction between them and the *Silphidæ*: nevertheless, as some authors insist upon an affinity between these latter insects, and such genera as *Leiodes*, *Agathidium*, *Catops*, and *Cholera*[*], we have no great hesitation in adopting their views, and placing the *Necrophaga* Latr. as part of the most aberrant family of the present tribe, under the more appropriate name of *Silphidæ*. Judging from analogy, however, we have an impression that *Pimelia* is the true type of this family: its analogy to the *Chrysomelidæ*, in its thick and globose body, is quite obvious; while its affinity, on one side to *Blaps*, and on the other to *Silpha*, are further inducements to our belief that this is their true station. All these insects, in fact, are in some degree carnivorous, although their animal food is only derived from dead or decomposed substances; they are the only *Predatores* which, in any degree, derive nourishment from vegetable substances. How far the *Engidæ* MacL., and such genera as *Erotylus*[†] really enter into this assemblage, or are merely its representatives in the circle of the *Monilicornes*, are questions of minor importance, which analysis can alone determine; the latter supposition, however, appears to us the most probable. Leaving these, we concur in the opinion of others as to the affinity of *Silpha* with the *Staphylinidæ* (*Brachelytra* Latr.), which we accordingly place as the last family of the predatorial tribe. That this is its true situation in nature, is manifested by the close resemblance of some of these genera, as *Stenus*, &c., to the *Cicindelidæ*. The circle of the *Predatores*, under this view, no less than that of MacLeay, would be thus closed; and the relations of the whole to the primary divisions of the *Coleoptera* may be thus stated: —

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[*] Latreille considered the *Parnidæ* so allied to *Gyrinus*, that he once included them in the same family; and, as both are more or less aquatic, they would seem to offer, with the above, additional links in the chain.

[†] "It is perhaps by the *Erotyli* that the opposite points of the circle of *Coleoptera* meet."—*Ann. Jav* p 40. And again, the same author observes, "As to the *Erotyli* being tetramerous, it is a circumstance to which little importance ought to be attached, since the five articulations of the tarsi are visible in several species; and other insects, which are close to the genus, such as Mr. Kirby's *Spheniscus*, are heteromerous.

Analogies of the PREDATORES *to the Tribes of* COLEOPTERA.

Families of the *Predatores*.	*Analogies.*	Tribes of the *Coleoptera*.
CICINDELIDÆ.	Pre-eminently typical in their own groups.	LAMELLICORNES.
CARABIDÆ.	Sub-typical, cursorial; legs highly developed.	PREDATORES.
DYTISCIDÆ.	Legs short, and greatly compressed.	MALACODERMES.
SILPHIDÆ.	Body often globose; tarsi very variable.	MONILICORNES.
STAPHYLINIDÆ.	Jaws exserted; head large.	CAPRICORNES.

(226.) Between groups which stand at the head of their respective circles, there can be but faint analogies of actual structure; but their very typical pre-eminence is in itself a point of strong analogy — as in the present instance. Every one is aware, again, that the *Cicindelidæ* are the most cruel tyrants of the predaceous beetles, and are much higher organised than the *Carabidæ;* since they not only run with greater agility, but add to their speed by short flights. On the other hand, we have seen that the lamellicorn insects are the most typical of the whole order, corresponding to the *Insessores* among birds, and to the quadrumanous *Mammalia*, by their power of grasping. It is a remarkable circumstance, that in such a vast assemblage of animals as the *Coleoptera* there is no *primary* group, which is aquatic, such as the natatorial order among birds, and the *Cetæ* among quadrupeds. Hence it is that, at first sight, there seems no sort of relationship between the soft-winged tribe of *Malacodermes*, and the aquatic *Dyticidæ*: nevertheless, we have no doubt that this is a true analogy; for these are the only groups where the legs in the great majority are decidedly compressed, and we might also say the least developed for either running or grasping. The uncertainty, already hinted at, as to the true type of the *Silphidæ*, leaves us in much doubt as to their direct analogy to the *Monilicornes*. But if, as we suspect, the *Pimelidæ* fill this situation, the difficulty of detecting their analogy is not very great; for every entomologist must confess that they are the *Chrysomelæ*, as it were, of the *Predatores*,—having moniliform antennæ; short, thick, and round bodies; and tarsi not much unlike each other. Lastly, the *Staphylinidæ*, dissimilar in every respect to the capricorn beetles, nevertheless possess that great protrusion of the jaws, which belong to all such types as represent the ruminating animals, and their representatives (like the toucans and hornbills) among birds. So far, therefore, we have proved this disposition of the predatorial beetles, which differs but slightly from that of MacLeay, to be strictly natural, not only from the affinities which connect each of their families, but by bringing this series to a test which has never yet been attempted.

(227.) The above comparison, however, is made between groups widely dissimilar both in rank and affinity: we shall, therefore, compare the predaceous tribe with that to which it is immediately connected; where, the relations being nearer, the analogies, of course, will be stronger.

Analogies of the Predatores *to the Families of* Lamellicornes.

Families of the *Predatores.*	*Analogies.*	Families of the *Lamellicornes.*
Cicindelidæ.	Pre-eminently typical in their own circles; colours brilliant; fly by day only.	Cetoniadæ.
Carabidæ.	Sub-typical; fly chiefly by night; colours dark.	Scarabæidæ.
Dytiscidæ.	Aquatic.	Hydrophilidæ.
Silphidæ.	Most aberrant from their own types; tarsi variable.	Buprestidæ.
Staphylinidæ.	Jaws considerably projecting.	Lucanidæ.

The rank of the *Cetoniadæ*, as the most typical of all the lamellicorn families, here receives additional confirmation; since these beautiful insects, in which white spots and lines upon a green ground are so very prevalent, fall in, as it were, exactly opposite the splendid *Cicindelidæ*, whose colours and markings are so remarkably similar. Two of the most common insects in this country, the *Cetonia aurata* and the *Cicindela campestris*, will bring this analogy home to the conviction of the most ordinary observer. It is no less remarkable, that nearly all the insects of these groups fly only during the day, and delight to bask in the sun. The greater part, however, both of the *Carabidæ* and the *Scarabæidæ*, are nocturnal insects, and still more resemble each other by their black and sombre colours. Such, at least, are the majority; for some few in each partake of the metallic green reflections of the chief types; but these are among those exceptions, and not the general character. The most satisfactory analogy, perhaps, in the table, is that which shows that the predaceous *Dytiscidæ*, although intimately connected to the *Hydrophilidæ*, are also their representatives. The connection of *Hydrophilus*, which, in fact, is a true lamellicorn insect, to the *Scarabæidæ*, by means of *Sphæridium* in one group, and *Aphodius* in the other, is, in our estimation at least, indisputable; although we are not prepared to offer any opinion, worth recording, how these aquatic lamellicorn insects are connected to the *Buprestidæ*. Our present business, however, is with analogies, not affinities. If our main groups are naturally located, we may leave their contents for future analysis. Passing, therefore, to the *Silphidæ*, we should have been at some loss to have detected their analogy to the *Buprestidæ*, but for that extraordinary insect, the *Helota Vigorsii* of MacLeay *, —a type which presents such a singular deviation from the rest of its congeners, that it would be perfectly anomalous, but for the direct relation of analogy it is now seen to possess with those insects it so strongly resembles. The analogies of the *Staphylinidæ* to the *Lucanidæ* are shown in the same characters of exserted jaws, which shows that both are prototypes of the capricorn tribe. It is also well worth observing, that the gigantic *Prionidæ*, among the latter, have their wing-cases very thin, and sometimes abbreviated, so that it is not improbable they represent the *Malacodermes* in their own circle.

(228.) After these expositions, it might be tedious to test the analogies of this tribe, by bringing its contents into comparison with others of the annulose circle: those we have now reviewed, appear quite sufficient to establish the existence of mutual relationships; but a few incidental references to the general principles upon which all insects seem to be constructed, will not be misplaced. The *Coleoptera*, as a whole, are the most imperfect flyers of all the *Ptilota*; and, therefore, it might naturally be expected that many would be apterous, — that is, unprovided with the pair of real wings usually concealed beneath the elytra; and these, therefore, would be the most aberrant of their congeners. Now, on looking to the most aberrant groups in the circles of the *Predatores* and the *Lamellicornes*, we find in one the *Pimelidæ*, and in the other the *Buprestidæ*; and in both these, the real organs of flight are very often either totally absent, or very slightly developed. A large proportion of the *Pimelidæ* are apterous, having no wings beneath their elytra; while these organs in the *Buprestidæ* are so short, that they require not to be folded when the insect is at rest, being not longer than the elytra. It is singular, also, that this absence of wings takes place also among many of the *Trogidæ*; which, as being the most aberrant group of the *Scarabæidæ*, corresponds to the *Pimelidæ* and the *Buprestidæ*. Many apterous insects occur indeed, both in the families of the *Cicindelidæ* and *Carabidæ*; and these, without doubt, will hereafter prove to be naturally located in similar positions in their own circles. Nevertheless, this character is obviously only of secondary consequence; and is here adverted to more for the purpose of showing its indication of extreme aberrant groups, than of laying on it a primary stress. Many of the African *Pimelidæ*, again, put on, as it were, the very aspect of the *Trogidæ*; so that an inexperienced observer might readily suppose they were of the same genus. Looking to the *Lamellicornes*, which represent the *Lepidoptera*, we see they are the most perfect flyers of all the *Coleoptera*: hence the apterous species are remarkably few; while in the *Predatores*, equally conspicuous for their running, the true wings are often wanting, as their absence is amply made up by the cursorial structure of their feet.

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* Annulosa Javanica, pl. 1. fig. 9.

(229.) We may conclude this sketch of the natural arrangement of the predatorial groups with the following table, wherein the analogies, although remote, are still in unison with the last.

Analogies of the PREDATORES *and the Orders of the* PTILOTA.

Families of the *Predatores.*	*Analogies.*	Orders of the *Ptilota.*
CICINDELIDÆ.	Typical of their own circles, colours bright, fly in the sun.	LEPIDOPTERA
CARABIDÆ	Sub-typical, colours dark; fly chiefly at night	HEMIPTERA
DYTISCIDÆ	Aquatic either in their larva or perfect state	NEUROPTERA.
SILPHIDÆ	The most aberrant and imperfect flyers	COLEOPTERA.
STAPHYLINIDÆ.	Jaws more or less exserted	HYMENOPTERA.

That celerity of motion, which is produced by *flying*, is certainly more developed among the *Cicindelidæ* than in any tribe of coleopterous insects; and as the *Lepidoptera* are the most perfect flyers of all the *Ptilota*; both these facts not only render these groups analogous, but tend to corroborate our theory, that perfection of flight is one, if not the very first, character of the annulose circle, just as it is of birds in that of the *Vertebrata.* On the other hand, there is an important difference to be remarked, if we look, not to the *Cicindelidæ* only, but to the whole order in general; for then it is obvious that the *Coleoptera*, with regard to motion, are the most imperfect flyers of the whole of the *Ptilota*, although they are the swiftest runners—or rather, are more terrestrial in their habits than all other winged insects. These are the chief points in the above table which it seems necessary to touch upon; and these remarkable analogies will be still further confirmed by placing the *Ptilota* in comparison with the orders of birds.

Analogies of the COLEOPTERA *to the* PERCHING BIRDS.

Orders of the *Ptilota.*	*Analogies.*	Orders of *Perching Birds.*
	1. *Typical.*	
LEPIDOPTERA.	The pre-eminent types of their own circles.	INSESSORES.
	2. *Sub-typical.*	
HEMIPTERA.	Sub-typical and rasorial.	RAPTORES.
	3. *Aberrant.*	
HYMENOPTERA.	Eminently social, and beneficial to man.	RASORES.
COLEOPTERA.	The most perfect walkers, and the swiftest runners.	GRALLATORES.
NEUROPTERA.	The most aquatic in their habits.	NATATORES.

Every ornithologist is perfectly aware that the sandpipers, curlews, plovers, &c., all being types of the grallatorial order, are the swiftest runners among birds *, just as we find the hares and mice to be among quadrupeds: thus do they represent the coleopterous order of insects, the types of which are the *Cicindelidæ* and the *Carabidæ.* An equally strong analogy, although not brought out in the above exposition, can be traced between the lamellicorn insects and the insessorial birds, in both of which the power, not of running, but of *grasping*, is at its maximum. Take a *Carabus* in the hand, and so soon as it feels itself at liberty, it runs away; but a chafer (*Melolontha*), although released, will absolutely cling to the fingers of its captor; such is the power of instinct. The philosophic reader will not fail to perceive, in all these analogous comparisons, additional evidence in support of our views, that, however the *Coleoptera* may be regarded as favourites among entomologists, they are, without exception, the most imperfect of all the *Ptilota*; and that, instead of being placed the first in a natural system, they really should come in as the last.

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* The half-flying half-running progress of the whole family of sandpipers is a precise counterpart of the progress made by the *Cicindelidæ*, when hunting for their prey.

(230.) We will now make a rapid survey of these families, and give a succinct view of their contents. The three first are distinguished from all other coleopterous insects by their possessing six articulated palpi, — two labial, and four maxillary; the external lobe of the maxilla being here converted into a palpus. The *Cicindelidæ* will first occupy us. We have already given a very general idea of a peculiarity in their habits; we may, however, further remark, that many of the tropical forms are not ground insects, but occur on plants, doubtlessly in search of prey. The distinguishing character that separates them from the large family of the *Carabidæ*, is one not readily detected without the microscopic inspection of the mouth, as it consists in the claw of the maxilla being articulated, and not anchylosed, as in the latter; but in the *Ctenostoma* this is not the case, —thus showing that rules are not absolute. There is, however, a general facies, which, when these insects are once known in their normal types, will readily guide a speedily acquired tact easily to distinguish them. They are generally of a slender, agile form, with long legs, and very prominent eyes. Larvæ of the typical *Cicindela*, only, we believe, are yet known; but should the habits of these be confirmed, it would help to give a determinate character to the group. Thus, the larva of *Cicindela campestris* forms a burrow, within which it lurks on the watch for any unwary insect that may incautiously come within the grasp of its capacious and prompt jaws. It is so formed, that it easily supports itself at the top of its cylindrical and vertical cell; for it has a couple of hooks upon a swollen segment, towards the apex of its body, whereby it is suspended; whilst its largely dilated prothorax completely fills the orifice of its den; and its formidable jaws being bent down, and concealed beneath, are thrown suddenly up when its unhappy prey is within itsreach, and which, like the tiger, it rarely misses. It then retires with it into the recesses of its cave, and devours it at leisure. Although it possesses long legs, it rarely uses these for the purposes of transportation; and, we believe, never, unless inconvenienced in its abode: whereas the larvæ of the *Carabidæ* roam about in search of their food, with the exception, only, of a very few genera, which also form burrows, although they occupy them only as retreats, and not as domiciles. The series of insects contained in the family of the *Cicindelidæ* are evidently very numerous, and of course exhibit very great varieties of form, which has led to their being subdivided into smaller families or sub-families, named in allusion to the preeminent genus, around which some few others are collocated; but we here regard them as a body, and cannot, in the small space we are enabled to devote to them, go into these minute particulars. The majority are not large insects, although some few are very conspicuous, and comparatively large; but not so when placed parallel to the *Carabidæ*. Many are apterous; which is the case with *Manticora*,—a second species of which has been recently described by Mr. Waterhouse; and *Platychile*, which is so rare, that we believe a half a dozen specimens are not known in Europe. Both of these are from South Africa. *Dromica* is also another apterous African genus. The Brazilian *Ctenostomæ* are remarkable for assuming the girdled figure of hymenopterous insects,—whence some of them derive their specific names; and *Colliurus* is distinguished for its elongated and slender form. *Therates* has a very large labrum, and occasionally spined elytra. The large *Omus* appears to be the North American representative of the South African *Manticora*, which insects are the largest in their family. Upon the habits of *Megacephala*, M. Lacordaire, who observed them in Cayenne, thus speaks:—"They are frequently observed running on sandy spots in woods; they rarely make use of their wings." Of the *M. Chalybea* he says, "Upon endeavouring to catch them, they retreat beneath dry dung, into the large deep holes made by the *Phanæi* and *Coprides*, and they try to defend the entrance when attacked; but finding this useless, they retire to the bottom of their hiding place; and the only means to extract them then is to introduce a long straw, which they seize with their powerful mandibles, and allow themselves to be dragged out without quitting hold. They are all usually beautifully decorated with metallic splendour, and are certainly the gayest of the predatory *Coleoptera*. To give an idea of their numbers, *Cicindela* alone is recorded to contain more than two hundred and fifty species.

(231.) Our second family consists of the *Carabidæ*, which will admit of subdivision into five very natural sub-families, thus to be distinguished: — 1. The *Brachininæ*, named from the typical genus *Brachinus*. The distinguishing characteristic of these insects consists in the abridgement of their elytra, which do not entirely cover the abdomen behind. They also, in common with the two next sub-families, have a deep notch within the anterior tibiæ. Both in form, and the general fragility of their structure, they greatly resemble the aberrant genera of the preceding family; and are, like them, frequently found upon plants where *Lebia*, *Dromius*, *Odocantha*, and *Demetrius* constantly occur. Some are so remarkable for an elongation of the neck,—namely, *Casnonia*,—that Linnæus associated them with the genus *Attelabus*, in the vicinity of the *Curculios*. There cannot well be a greater contrast than that presented by *Trigonodactyla* and *Lebia*, — the one very elongate and slender, the other broad and depressed. But the most extraordinary form throughout the circle is certainly that of *Mormolyce*, the true position of which is doubtlessly in the vicinity of *Agra*. It is a Javanese insect, and is distinguished for its excessively flattened form: it has an elongate neck; lengthy antennæ and elytra, which, although truncated at their apex, have their sides dilated into a thin leaf, and extending beyond this apex; and the legs very slender. It is said to live upon trees. In elegance, perhaps, all are exceeded by the beautiful *Drypta* of the Old

World, or *Agra* of the New World. *Brachinus* possesses the peculiar property of crepitating when irritated or captured, and the noise is accompanied with a bluish smoke; these insects have thence obtained the name of bombardier beetles. The Indian *Catoscopus* is reputed to have the same means of defence. These insects are less absolutely predatory in their disposition than the other sub-families of the *Carabidæ;* and many of them are gregarious,—associating in large troops beneath stones, or under the bark of trees. They are universally distributed, and appear more numerous than the *Cicindelidæ*. The second sub-family are the *Scaritinæ;* these are essentially fossorial insects. They are elongate and depressed, and the abdomen is affixed to the thorax by means of a short peduncle, whereby the latter acquires a degree of motion which greatly facilitates its burrowing habits; their antennæ are short and moniliform; and the legs also are short, —the anterior tibiæ being dilated into a broad, palmated, externally denticulated burrowing implement. It is a small group, very widely distributed; few genera of these consisting of nearly solitary species being peculiar to any country,—for instance, *Acanthoscelis* to the Cape, *Scapterus* and *Oxygnathus* to India, *Oxystomus* and *Camptodontus* to the Brazils, *Carenum* to New Holland, and *Pasimachus* to North America;—species of the latter frequently come over in raw turpentine.

(232.) The third sub-family is the *Harpalinæ*, the distinctive characters of which consist primarily in the enlargement of the four anterior tarsi of the males; they have moderately long antennæ; and, in common with the preceding, possess a deep notch in the inside of the anterior tibiæ. They are generally robust insects, and perhaps, with the *Carabinæ*, are the most voracious of the entire circle. But we have the extraordinary apparition of vegetable feeders in the midst of them. Thus, *Zabrus* is said to feed exclusively upon corn; and many of the *Amaræ*, upon the tender shoots of grass and plants, as also upon their roots. This is a very extensive sub-family, containing many genera, and distributed throughout the known world. They have been broken up into named sections; and the genera are constructed upon peculiarities in the form and structure of the palpi and mentum, conjointly with the external shape. The most voracious are probably *Broscus* and its allies, and the type *Harpalus*; and the most conspicuous forms are doubtlessly *Hypetion Schrœteri* and *Catadromus*, both New Holland genera, and the giants of the tribe.

(233.) The fourth sub-family consists of the normal *Carabinæ*, and from which, if *Cychrus* and its affinities may be associated with them, we certainly cannot agree to separate *Elaphrus* and its allies. The prominent character of this fine sub-family is to want the notch in the anterior tibiæ. They are also, viewing them in their types chiefly, more bulky insects than any in the family, and also more convex; and amongst them are certainly some of the most elegant. None of the whole of this circle can compare with *Procerus* in size, or with *Pamborus* and *Tefflus* in form and size combined; whereas *Carabus* presents us with many brilliantly metallic insects—for instance, the *Regalis, splendens,* and *rutilans*. *Cychrus*, and its affinities, are evidently considerably more aberrant from the whole of this group, than any other form: in its apterous condition, connate elytra, securiform terminal joint of the palpi, and in the external lobe of the maxilla being not palpiform, it seems to point directly towards the *Heteromera*. To this anomalous group belong *Sphærodcrus* and *Scaphinotus*, both American genera. *Elaphrus*, and its sub-aquatic cognates, appear to depart widely, also, from the normal features of the sub-family: in the prominency of their eyes, and active ferocity, they evidently have an affinity to the *Cicindelidæ*, with which Linnæus associated them; and it is through them, from the affinity of habits, that we most conveniently pass into the fifth sub-family, the *Bembediinæ*,—the whole of which, as their characteristic signature, have subulated maxillary palpi. As the preceding sub-family were the giants of the *Carabidæ*, so are these the dwarfs, for amongst them we have some of the smallest Carabideous insects. They all frequent humid situations; and many, when captured, exhale offensive odours: they are exceedingly active, as their names frequently indicate,—for instance, *Tachys*, *Ocys*, *Tachypus*, which have all reference to this peculiarity; and from this, in combination with their habitat, they might not inaptly be styled coleopterous Wills o' the wisp. By means of the little gibbous genus *Omophron*, the present family merges into the next, for it has a most remarkable resemblance to *Haliplus* and *Cnemidotus*.

(234.) The *Hydrodephaga*, or *Dytiscidæ*, constitute our third family. This group, compared with the former, is of very small extent. They retain all the prominent characters of the preceding family; for, being *aquatic Carabidæ*, their structure is only so far modified as to suit the different element they are intended to inhabit; and the reason of the smaller diversity of form observable in them throughout all latitudes, is the limitation and uniformity of the functions they have to execute. The only peculiarity we remark in their distribution is, that *Cybister* is evidently tropical, for of it we have but one representative in this country, and only three species occur to the north of 35° of northern latitude; whereas *Dytiscus*, which here takes its place, does not occur to the south of the Tropic of Cancer. The males of all the larger genera of these insects are remarkable for the scutellated enlargement of their anterior tarsi, which form frequently a circular disk supplied beneath with a cluster of small sucking cups for the purposes of sexual adhesion; and a peculiarity in the majority of the females of males so furnished, is to have their elytra deeply furrowed longitudinally. They are exceedingly voracious insects in all their stages, but especially in the larva state; for all that their strength or dexterity can overcome do they prey upon, and small fish and the fry of larger ones are not free from their attacks. They possess this peculiarity in their larva state,—that, although furnished with capacious jaws, they do not masticate their food; for these jaws are merely prehensile organs, and are tubular and perforated towards the extremity: their acuteness wounds the prey caught, which is then sucked dry through this tube. Their progression in the water is effected in jerks or springs, caused by the sudden expansion of their bent tapering tails; and they direct it with that precision, as to pounce as readily upon their prey as a cat does on a mouse. The perfect insect, if not alarmed, is stately in its motions,—proceeding always in an oblique direction through the water, to the top of which it frequently comes for the purpose of inhaling fresh atmospheric air; this it does by protruding the apex of the elytra above the surface, and thus receives beneath them a quantity sufficient for the supply of the spiracles which are situated there. The small genera, such as *Haliplus*, *Cnemidotus*, *Hydroporus*, *Pælobius*, &c., are much more active than the larger ones, and move about with the greatest velocity in every direction, sporting with each other in the merriest gambols. *Cnemidotus* presents a remarkable singularity in the structure of the posterior coxæ, which are dilated externally into a thin plate, beneath which they receive and conceal the posterior legs. We have associated with this family, the *Gyrini*, or whirlwigs; thus named from their habit of swimming in circles upon the surface of the water. Their activity is excessive and incessant; and the structure and combination of their muscular fibre must be remarkable, to admit of such interminable and rapid motion. The whole structure of the larva and imago, also, is very different to that of the preceding section of the family: thus, in the perfect insect, the antennæ are thick and fusiform, with a large auriculated joint at their base; their legs are considerably dilated and compressed,—the anterior being the longest and most slender, evidently for prehension; and the posterior tarsi consist of laminæ folding apparently upon one joint. Their larva is elongate and depressed; and each segment, beyond the three thoracic ones which bear the slender legs, is furnished laterally with an elongate, inarticulated, ciliated filament; and the thirteenth with four articulated, very pilose appendages, of about the same length as the lateral filaments. When it has acquired its perfect size, this larva creeps up some aquatic plant, where it spins a cocoon wherein it undergoes its transformation; thus, also differing from the *Dytiscinæ*, which undergo theirs beneath the earth, and do not spin a cocoon. Of the many water beetles collected by Mr. Darwin during his voyage with the Beagle, the majority were minute and well known forms resembling those occurring in our own country.

(235.) Being uncertain whether the *Silphidæ* or *Pimelidæ* should occupy the situation of our fourth family, we will give a brief description of the most remarkable contents of each. The relation between the *Dytiscidæ* and them, it is at present impossible to trace without straining affinities; and the *Silphidæ*, in particular, of which we will first treat, are considerably different, both in habits and structure, from all that have preceded them in this circle; although connected, by means of both, with the *Staphylinidæ*. Their antennæ are clavate, the club being perfoliated; their elytra usually abbreviated; and in the aberrant forms of the family, there is much divarication, and even sexual disparity, in the number of the joints of the tarsi,—although, typically, they are pentamerous. The chief types, consisting of the genera *Necrophagus*, *Necrodes*, and *Silpha*, and feeding as they do upon carrion, are, like the vulture, endowed with the sense of winding it from afar; and upon a bright spring day they will come soaring along, sweeping with the velocity of a bee around the object of their solicitude, and fall directly upon it. The species of *Necrophagus* are called burying beetles, from the habit they have of associating together for the purpose of excavating the earth from beneath the dead animal (if not too bulky) with which they are engaged, which sinks gradually into the ground, and they then cover it over with loose soil and deposit their eggs in it. The larva is speedily developed, grows rapidly to its full size, and then buries itself to undergo its subsequent transformation. Nature, universally, carefully conceals these changes; she will not, voluntarily, admit a spectator in her tiring room; and if we wish to witness these transmutations, it must be done by subterfuge, — and even when exercising all that we are capable of, she will frequently evade us. Hence it is, that we know so little of the transformations of insects, — a subject, however, replete with the greatest interest, and one, the careful notice of the progressive stages of which we cannot too strongly inculcate the due observation of, when those fleeting and rare opportunities present themselves. These insects frequently emit a sort of musky odour, which would be far from disagreeable were it exhaled by a flower; but proceeding, as we assume it does, by secretion, from the nauseous substances they inhabit and feed on, our imagination makes it loathsome, and thus evinces how much we are the slaves of that faculty. In some, which are most approximate to the typical *Necrophori*, — namely, *Necrodes*, — the posterior thighs are frequently thickened. *Silpha* itself, and its closest allies, are flat or hemispherical; and the *Nitidulæ* are distinguished by the enlarged basal joint of the antennæ: the various forms this takes, and the various relative proportions of the following joints, and of the club, which is sometimes solid, with merely transverse sutures, or consists of three successive joints, or sometimes four or more are incrassated, have divided this group into a multitude of small genera, the habits of which present some diversity, although they frequent resembling substances. Thus, some occur with the types in carrion, as *Nitidula* proper, which is the most numerous genus of all; others are found in fungi, as *Atomaria*, *Triphyllus*, *Mycetophagus*, *Phloiophilus*, and *Strongylus*; others occur only in flowers, as *Byturus*, *Cateretes*, *Meligethes*, and *Antherophagus*; many beneath the bark of trees, as *Ips*, *Engis*, *Tetratoma*, and

Thymalus; others are found by sweeping in low herbage, as *Typhæa, Mycetæa,* and many *Cryptophagi;* and many occur in heating heaps of garden rejectamenta, as *Anisarthria* and *Trichöpteryx,*—the latter is distinguished by being the most minute of all *Coleoptera,* and having their delicate wings fringed with fine hair, which, when folded beneath their closed elytra, protrude like a couple of pencils. As aberrant forms in this family, we may view such genera as *Cholera, Scaphidium,* and *Leiodes,* and their allies, all distinguished by the club of their antennæ consisting of five joints, the eighth of the organ, the second of the club, being disproportionally minute. With these associates also *Agathidium,* that rolls itself up like a ball, yet less spherical than we have observed in *Acanthocerus* among the *Troginæ;* and here, contiguously, must be placed the still more remarkable *Clambus,* which, under the apprehension of danger, closes its large broad head upon its four anterior legs; whilst the protection of the posterior pair is referred to the broad enveloping plate, formed, as in *Cnemidotus* among the *Dytiscidæ,* by the dilatation of the posterior coxæ. All of these, like the majority of the *Nitidulinæ,* are fungivorous; and the *Leiodes Cinnamomea* feeds upon the truffle. Of course, we here can enumerate only the most conspicuous forms, and must refer the location of the rest to the determination of their affinities. The exotic forms are comparatively few, probably from their being minute, and not having yet had sufficient attention bestowed upon them; but some among them are sufficiently remarkable;—for instance, the very extraordinary *Hypocephalus armatus* is referred to this group, and placed near the *Necrophori.* This is, perhaps, one of the most grotesque forms the *Coleoptera* can exhibit. It is a large insect, more than two inches long, with a greatly developed thorax, not unlike that of a *Calandra;* its head is small and deflexed; antennæ short and moniliform, as are also its palpi; the mandibles are somewhat distorted and curved; the maxillæ large, prominent, and triangular; it has the elytra of a *Carabus;* the four anterior legs very robust; and the two posterior incrassated like those of *Sagra;* with largely developed coxæ; and the apex of their tibiæ flat and vesicular beneath, like the anterior ones of *Pirates* among the *Reduviinæ*, in the *Hemiptera*. This incongruous compound of anomalies is of a dark chestnut colour, and is a native of the interior of the Brazils, whence it was first brought by prince Maximilian of Neuwied, and was originally scarcely believed to be more than the unskilful workmanship of some cozening dealer,—so complete a burlesque did it seem upon Nature's general harmony of structure: but others have since been brought, and the authenticity of the monster is confirmed. We possess an undescribed extraordinary Brazilian *Nitidula*, in which the anterior tibiæ are bent inwards, at right angles, at their middle,—the lower half being considerably dilated, and the tarsi inserted before their termination. It is excessively flat; and being a very distinct genus, we propose for it the name *Plax adunca*. We have before spoken of the very singular *Helota*, of which several species are now known.

(236.) The *Pimelidæ*, which may perhaps fill the place of the *Silphidæ* in this circle of *Predatores*, form a group of insects of a most extraordinary and repulsive aspect. They are all heteromerous,—that is to say, the posterior pair of tarsi have one joint less than the four anterior; but this is a peculiarity which extends over a large mass of the *Coleoptera*, many of which we shall have to consider when we treat of the *Malacodermata*. For the present, we may state, that an additional characteristic of these insects is, to have the third joint of the antennæ the longest; their elytra soldered together, and frequently hispid with innumerable spines, teeth, or tubercles; and they are, besides, usually of ungainly gibbous forms. They are pre-eminently the inhabitants of deserts, wastes, and arid sandy tracts, especially Northern and Southern Africa, and Patagonia, where Nature is most inhospitable and cheerless; and they thus participate in the features of the districts they occupy. Their colour harmonises with their form, to make them hideous, for they are invariably of a deep black or dirty brown. *Epiphysa* offers us the most gibbous form amongst them. In *Cryptocheile* and *Adesmia*, this form is covered with short spines or tubercles, placed either irregularly over the whole surface, or arranged in rows between which there are furrows. In *Pimelia* proper, and *Moluris*, we have the gibbous form also greatly developed, but with a deep strangulation between the thorax and abdomen: and in *Prionotheca*, the same general form is somewhat flattened, and the lateral superior edges of the elytra are armed with a coronet of protruding spines. In others, we observe them taking the more general figure of *Carabidæ*, as in *Scaurus* and *Trachynotus*; and in others again they become exceedingly flattened with dilated edges, as in *Eurychora*; and which, in *Steira*, is furnished above with longitudinal carinæ. Among the aberrant forms, we may notice the extraordinary *Helæus*, which is very like a black *Cassida*, with a perforation through the dilated margin of the thorax, for the head to exhibit itself; and in one species the whole of the central convex portion of the insect is covered with erect rigid setæ; and amongst the most heterogeneous of these forms, *Machla* claims a place. The affinities of this group to the circle are obscure, and difficult to trace; their position is suggested for the analytical examination of entomologists.

(237.) The *Staphylinidæ*, or rove beetles, constitute our fifth group of predatorial insects: their distinguishing characteristic, as we have above said, is to have considerably abridged elytra, beneath which their expansive wings are folded up; and thus there are almost always more, and never fewer, than four segments exposed. As in the *Coleoptera* generally, their antennæ consist of eleven joints, rarely of ten, and the apex of their abdomen is usually furnished with a couple of retractile vesicles. There is great diversity in the number of the joints of their tarsi, but the typical number may be considered as five. They are excessively active insects, promptly take wing, and fly with considerable velocity. They frequent coprophagous substances of all kinds, and in which they associate sometimes in considerable multitudes,—so much so, that the very surface of it is sometimes wholly alive with them, and by them it appears transformed into a living mass. They have been subdivided into seven distinct subfamilies; the structure of which differs considerably in minute points of a highly interesting nature, in its investigation, to the systematist. The largest majority of these consist of minute insects, comparatively few of which exceed half an inch in length, and the major part are under a line. They appear to be, with very few exceptions, a northern group, replaced within the tropics, in the exercise of the peculiar function awarded to them by the ants; although some few also occur there. These, especially the Brazilian ones, like the prevailing character of its entomology, are of brilliant metallic splendour.

(238.) They consist, first, of the *Staphylini* proper, which contain the largest species of the whole family, and are chiefly distinguished from the rest by their fissile labrum, and tarsi always pentamerous. They are courageous insects, and resist aggression, and endeavour to intimidate by opening their powerful jaws; with which, indeed, they can pinch severely. They also have the habit of erecting their tails, to produce intimidation; and it is by the flexibility of this part of the body that they are enabled promptly to fold their wings beneath the elytra; and the activity with which this is done, is highly interesting. Their larvæ are depressed, and have similar habits of life to the perfect insects, and, like them, occur most abundantly during the spring and autumn. The most interesting genera are *Velleius*, which has serrated antennæ, and is said to frequent the nests of hornets,—whether as a parasite, or in quest of prey, is not determined. *Creophilus* is the common black large-headed species, mottled with grey, that occurs so frequently in our walks. *Emus* is a beautiful insect, densely pubescent, its clothing being party-coloured, black and bright yellow; and the Devil's coach-horse, the common *Goerius*, is the frequent occupant of our gardens. *Oxyporus* is remarkable for its moon-shaped palpi; and a modification of this form occurs in *Astrapæus*, *Tasgius*, and *Pelecyphorus*. *Achenium* and *Siagonium*, lastly, have porrected horns upon the head and thorax.

(239.) The second family, the *Stenidæ*, have greatly the appearance of *Elaphri*, and, indeed, participate with them in their attachment to humid situations. They are nearly cylindrical; have very prominent eyes, long exserted palpi, and antennæ subclavate at the tip. They are very active insects, and seem very predaceous.

(240.) The third family are the *Oxytelidæ*: these are depressed, have very large heads, very serrated tibiæ, and usually but three joints to their tarsi,—the terminal one being longer than the rest together. There is nothing peculiar in their natural history, beyond the circumstance of their being, perhaps, the most gregarious of the group, associating in the multitudes we have instanced above, and occurring in dung and putrid substances.

(241.) The fourth family are formed by the *Omalidæ*, which, as their name indicates, are exceedingly depressed; their tarsi are pentamerous; and the terminal joint of their palpi is frequently subulated. These insects are often found in flowers, and are interesting, from presenting instances of the rare occurrence of ocelli in the *Coleoptera*.

(242.) The *Tachynidæ* form the fifth family, and are distinguished by their convex tapering forms; their tarsi are also pentamerous; and they have, likewise, the habit of frequenting flowers. They are excessively agile, and readily escape capture by the velocity of their motions. There is nothing strikingly distinguishing in them to require notice in a work thus general.

(243.) The *Aleocharidæ* constitute the sixth family: their antennæ are inserted below their eyes, which is the only general character which seems to pervade them; for they present numberless diversities of form, and remarkable anomalies in the numerical relations of the joints of their tarsi. The knowledge of these particulars must, of course, be referred to other works. They comprise the greatest number of insects of any of the families of *Staphylinidæ*, and differ as much in their habits as their forms. Thus, some, as *Pella*, *Dinarda*, *Lomechusa*, occur only in ants' nests; *Deinopsis*, *Diglossa*, *Oxypoda*, amongst rejectamenta; *Falagria* and *Astilbus*, in moss; *Homalota* and *Calodera*, beneath the bark of trees. *Deinopsis*, *Diglossa*, and *Myllæna*, are remarkable for the protrusion of their labial palpi as setæ; and *Callicerus* has beautifully formed antennæ.

(244.) The *Pselaphidæ* form the last family, if properly they be a constituent of the *Staphylinidæ*; for they differ so considerably in many particulars, and agree in so few, that we think they should compose a distinct group. They are the smallest and the most elegant of the series, and are distinguished by their clavate and frequently nodose antennæ; elongate clavate palpi; three-jointed tarsi, which terminate in a single claw. The only character they have in common with the *Staphylinidæ*, is the abbreviation of their elytra; for their abdomen is usually bulky, and incapable of reflexion. They occur in the nests of ants, at the roots of grass, and in moss in damp situations. They are very voracious, and feed upon living insects. In the observations on the *Hymenoptera*, we have already alluded to the remarkable *Claviger*; and, by so singular a form, we may quit the *Predatores*. [(230—244.) W. E. Sh.]

CHAP. VIII.

COLEOPTERA, *continued.*

CAPRICORNES.

(245.) FROM the close affinity, already remarked, between the *Lucanidæ* and the *Prionidæ*, there can be no doubt that the lamellicorn and capricorn tribes are united. This union, which has long been admitted by modern writers, will now be confirmed by additional evidence, founded on the general laws of natural arrangement upon which our entire theory reposes. Mr. Macleay, looking only to the formation of the larvæ, or more properly to the metamorphosis, hesitates not to place the capricorn beetles between the *Lamellicornes* and the *Monilicornes*. This conclusion we have also come to, from studying the perfect insects, and by testing the theory by our own impression of the laws of representation.

(246.) The chief or typical characteristic of this tribe, presented by the adult insect, is the great length of their antennæ, their large and vertical head, and the unusual strength of their jaws: the construction of their tarsi is also peculiar, and they are all, while in their larva state, lignivorous, or, at least, living in the internal substance of vegetables; chiefly, however, in solid wood. Hence it is, that although many of the groups, which we shall here consider aberrant, are very different, in their adult state, to the pre-eminent types, they agree with them much more closely in the general shape of their larvæ. This form of larva, by Macleay, is termed Apod, and is defined as "having scarcely the rudiments of antennæ, and furnished, instead of feet, with flat fleshy tubercles, which, when continued along the back and belly, give the animal a facility of moving in whatever way it may be placed." Our author cites *Curculio* or *Cerambyx* as examples. It may be observed, however, that these larvæ are not completely apodal, since they have the rudiments of six scaly minute legs with joints, yet so small as to be useless for locomotion. We thus find that considerations, drawn from the larva state of an insect, are often of the highest importance, and that in certain cases they may be employed with great advantage, without elevating them too high in the scale of primary and absolute distinctions. Under the impression, therefore, that this tribe contains within itself all such lignivorous insects as have apode larvæ, we have no hesitation in adopting the above views, — more especially as they will be subsequently developed more in detail.

(247.) The above definition of the perfect insects of this order is entirely drawn from the two typical families, the *Cerambycidæ* and the *Lepturidæ*, with which, however, the group connecting it to the *Lamellicornes* (the *Prionidæ*) is intimately allied. Of the two others, one (the *Curculionidæ*) is remarkably unlike either of the preceding, and the other is involved in some doubt. Without attempting, therefore, to find any more general characters for the *Capricornes* than those already glanced at, we may at once proceed to characterise with much brevity the primary groups or families into which we divide the tribe. 1. The *Prionidæ*, at once distinguished by their depressed form, their protruding or exserted jaws, directed forwards, and the comparative softness of their wing cases. 2. The *Cerambycidæ*, having their head large and vertical, the jaws short and sharp, the tarsi prehensile, and the thorax nearly as broad as the body: these, like the last, feed both in their larva and perfect state, upon solid or decayed wood, and are strictly lignivorous. — 3. The *Lepturidæ*, or floral capricorns, of a much more delicate and slender form, having the jaws or mandibles more lengthened and straight, the tip hooked, the legs cursorial, and the first joint of the tarsi long; the thorax is always narrower than the body, and is generally either spined or wrinkled: the perfect insect is floral; that is, feeds upon living vegetables and flowers. — Of the extent of the 4th family we feel very uncertain; but we are disposed to consider the major part of the *Xylophagi* of Latreille as forming a part, at least, of the group, regarding *Bostrichus*, or *Tomicus*, as the type of a family of lignivorous insects to which *Clerus* is unquestionably related either by affinity or analogy. — The 5th and last family is the *Curculionidæ*, or snout beetles, connected to the former by means of *Bruchus* and the *Anthribides*, through *Hylurgus*, &c. Nearly the whole are distinguished by the prolongation of their snout, which forms a rostrum, at the extremity of which is a very minute mouth. The antennæ, which in the first three families is usually as long as the body, and generally much longer, is here comparatively short, and is almost always bent into an angle in the middle, as if broken.

(248.) The above arrangement of the primary divisions is founded partly upon synthesis, and partly from analysis. The situation of the *Prionidæ* cannot be questioned; because, being united in the most intimate manner to the *Lucanidæ*, it necessarily follows they must be placed in that part of their own circle which brings them into immediate contact with their prototypes among the *Lamellicornes*. The difficulty respecting these insects does not lie in their station, but in ascertaining what other lignivorous genera are naturally associated with them. It is quite clear that the old genus *Prionus* contains merely the typical examples; so that we have no scruple in placing Latreille's *Platysoma* (including *Cucujus*), and perhaps most of his *Trogosita*, excepting *Trogosita* itself, as aberrant forms: but how many others, among the host of small or minute lignivorous genera (now broken up and elevated to the rank of small genera), are naturally associated with them, it is, at present, utterly impossible to say. The whole of the *Lucanidæ* and the *Bostrichidæ*, no less than the *Prionidæ*, require a thorough analysis; and until that is done, individual opinion, founded only on conjecture, can alone be offered. The nature of the food, and the form of the larva, indeed, may materially assist us in unravelling the confusion which now involves all these groups. Details like these, however, belong not to our present plan. We merely seek to establish the primary groups, and to show they exhibit as strong relations of analogy among themselves as are found in other parts of the animal kingdom. It can hardly be disputed, for instance, that there is a strong relation between *Passalus* and *Trogosita*, as well as between *Cucujus* and *Hister*; but these, we suspect, will eventually prove merely analogical.

(249.) In respect to the two typical families, the *Cerambycidæ* and the *Lepturidæ*, we feel much more confident, — not, indeed, as to their specific contents, but as to the fundamental principles upon which we should base them. As we prefer, upon all occasions, the retention of Linnæan names, when they can be preserved without injury to science, we call the first of these the *Cerambycidæ*, although, strictly speaking, the genus *Lamia* of Fabricius is the pre-eminent type. The natural history of the *L. amputator*, so beautifully illustrated by Guilding, one of the most accomplished zoologists of the age, completely establishes the fact, if such evidence were wanting, that these insects are lignivorous, both in their larva and perfect state: they feed, in fact, upon hard wood; and even amputate branches, without paying any regard to the leaves; and their thick, strong, and compact structure are in unison with such habits. The *Lepturidæ*, on the other hand, although internal feeders in their larva state, are yet totally incapable of gnawing hard substances when arrived at maturity. Whether they occasionally feed upon leaves, we know not, but their common resort is flowers, upon which the most inexperienced student has, no doubt, often captured them. Their light and elegant shape, cursorial feet, and small head, offer a contrast to the *Cerambycidæ*. With regard to the fourth type, we have already expressed our doubts, chiefly arising from a deficiency of analysis. We were long disposed to think that this part of the series was naturally occupied by such genera as *Sagra* and *Crioceris*, particularly as Latreille places them immediately in conjunction with *Leptura*, — a station, after all, they may possibly hold; but their still closer affinity, as we conceive, to the *Chrysomelidæ*, prevents us from following such high authority. Satisfied, for reasons that will presently appear, that the *Curculionidæ* were the most aberrant family of the *Capricornes*, our next object was to find what group was most likely to connect these, in some degree, with the *Lepturidæ*, by means of *Attelabus*, which Latreille very judiciously arranges close to the *Curculionidæ*. On these grounds have we formed the conjecture that most of the *Bostrichi* intervene between these two families, — more particularly as we do not think they form a part either of the *Lucanidæ* or the *Prionidæ*. By this means, also, the evident affinity between *Bostrichus* and *Clerus* may be preserved, if we consider the latter as leading to the *Coccinellidæ* and *Chrysomelidæ*, the former of which they resemble by the carnivorous habits of their larvæ. All this, however, as we stated before, must be considered a mere matter of opinion, until the groups to which these several insects are in any way related are thoroughly analysed.

(250.) We may now turn to the analogies resulting from the above arrangement of the whole tribe; and as the most difficult of these will regard the *Curculionidæ*, we shall commence by the following comparison.

Analogies of the CAPRICORNES *to the* TYPICAL VERTEBRATA.

Tribes of the COLEOPTERA.	*Analogies.*	Orders of the MAMMALIA	Orders of BIRDS.
Lamellicornes.	Legs formed for grasping.	*Quadrumana.*	*Insessores.*
Predatores.	Carnivorous; and rapacious.	*Feræ.*	*Raptores.*
Malacodermes.	Feet short or none, much compressed.	*Cetacea.*	*Natatores.*
Monilicornes.	Most aberrant.	*Glires.*	*Grallatores*
Capricornes.	Appendages to the head highly developed, either in the shape of horns, crests, or antennæ	*Ungulata.*	*Rasores.*

Without detaining the reader by additional explanations on the first four of these resemblances, we shall merely premise that the two last columns are arranged strictly according to their affinities as explained in former volumes, and that the analogies are expressed horizontally. We thus find the capricorn beetles fall in a line with the ungulated quadrupeds (or the oxen, antelopes, and all other horned genera), the representations, as every zoologist knows, of the peacock, turkey, and other rasorial birds. As this comparison, therefore, establishes the analogy of the two groups in a general way, we may now proceed a step further, and ascertain how far this theory holds good when we come to examine the contents of each.

Analogies of the CAPRICORN TRIBE *and the* UNGULATED QUADRUPEDS.

Families of the *Capricornes*	*Analogies.*	Tribes of the *Ungulata*
PRIONIDÆ.	Size gigantic, body thick, heavy.	PACHYDERMATA.
CERAMBYCIDÆ.	Strong, robust.	SOLIPEDES.
LEPTURIDÆ.	Slender, graceful, horns or antennæ very long.	RUMINANTES.
BOSTRICHIDÆ.	Thick obtuse snouts; prone aspect; antennæ short.	ANOPLOTHERES.
CURCULIONIDÆ.	Head produced into a long snout or rostrum; mouth terminal, very small.	EDENTATA.

(251.) We may here intimate to such of our readers as are unacquainted with the animals composing the *Edentata*, that the long-snouted ant-eaters and the armadillos are here designated; and so perfectly do the first of these represent, in their long snout, the attenuated rostrum of the *Curculionidæ*, that it is almost inconceivable how a quadruped and an insect can be such prototypes of each other. The *Pachydermata*, or the elephant, the rhinoceros, &c., are as truly the giants of the ungulated quadrupeds, as the bulky *Prionidæ* are of the capricorn tribe. The inferior development of the foot in the *Cerambycidæ* and of the *Solipedes*,—the tarsi of one corresponding to the hoof of the other,—is not a little remarkable; while the *Lepturidæ*, with their long and slender legs and their agile movements, find their appropriate representative in the graceful antelopes. The uncertainty that hangs over the *Bostrichidæ* prevents us from offering any conjectures on their analogy to the *Anoplotheres*; and this latter group, also, from being chiefly known by its fossil remains, contains but very few types. Upon the whole, however, this is not a matter of much consequence, seeing that the analogies of the other four groups are as perfect as the great distance between the groups themselves, in point of affinity, will admit. Our main object, in fact, was to draw the reader's attention to the analogy of the snout beetles and the ant-eaters; in doing which, the other resemblances, which previously we had never thought about, came suddenly to light while drawing up the table. That the analogies of the *Curculionidæ* should be more apparent among quadrupeds and birds, than among annulose animals, or even insects of the same order, is not a little singular; but such is undoubtedly the fact, for there are few other beetles possessing an elongated rostrum. This is additional proof that analogies can never be fully traced or even understood without a general knowledge of all the classes of animals, and that they may be altogether obscure in one group, while they become perfectly apparent when sought for in another.

(252.) The *Curculionidæ* being, therefore, the most aberrant family of the capricorn circle, we may glance at those other groups, which are similarly situated among the lamellicorn and predaceous divisions: these are, the *Buprestidæ* in the first, and the *Silphidæ* in the second. *Buprestis*, indeed, offers two points of analogy with *Curculio*, — in being, like them, internal feeders upon wood, and in the dilatation of their tarsi; but in all other respects the two groups are widely different, and, in their perfect state, have not the least similarity to each other. On turning, however, to the *Silphidæ*, or rather to their possible representatives the *Pimelidæ*, the analogy between certain groups is very remarkable: thus, for instance, the large apterous forms among the African *Brachyceri*, with their globose black bodies, immediately remind us of certain *Pimeliæ*, more especially of the Fabrician *Pimelia* and Latreille's *Molluris*; and in all these are shadowed out the typical form of the *Chrysomelidæ*, and other *Monilicornes*, — obscurely, indeed, yet still sufficiently to add additional evidence to that already adduced.

(253.) The analogies of this tribe to the *Lamellicornes*, again, is not without interest; for although the relations, to all appearance, are remote, there is nothing to militate against the supposition that the primary groups represent each other.

Analogies of the CAPRICORNES *to the* LAMELLICORN *and the* PREDATORIAL BEETLES.

Families of the *Lamellicornes.*	*Analogies*	Families of the *Capricornes*	Families of the *Predatores*
CETONIIDÆ.	Legs elongated, cursorial; colour bright	LEPTURIDÆ.	
SCARABÆIDÆ.	Form thick, heavy; colours dark, feed often on decayed substances.	CERAMBYCIDÆ.	CARABII
LUCANIDÆ.	Jaws unusually exserted; elytra sometimes abbreviated.	PRIO	STAPHYLINIDÆ.
BUPRESTIDÆ.	Larva concealed in other substances.	CURCULIONIDÆ.	SILPHIDÆ
HYDROPHILIDÆ.	?	BOSTRICHIDÆ.	DYTISCIDÆ.

As the capricorn and the lamellicorn tribes live upon vegetables, they are of course more analogous to each other, than either of them are to the *Predatores*, where the food is so totally different. We shall, therefore, say nothing of this last column in our table, but confine ourselves to illustrating the tribe we are now more particularly engaged upon. While rejecting the tarsal system, adopted by our modern nomenclators, as totally at variance with all natural classification, we yet attach no small importance to the different construction of the foot, whenever we find it is accompanied by other decided and general characters, whether of economy or of structure. When used with caution, it will assuredly lead to most satisfactory results, of which the arrangement of the two chief lamellicorn families (the *Cetoniadæ* and the *Scarabæidæ*) is a striking instance. Now, it is very obvious that each of these find their prototypes among the capricorn beetles. The elegant and highly ornamented *Cetoniadæ* correspond with the *Lepturidæ*, in having their tarsi long, linear, or cylindrical: both live also upon nearly the same food, and may be even seen upon the same flowers. The *Scarabæidæ* and the *Cerambycidæ*, on the other hand, have a form and an economy very different. They are both more bulky and inactive, and have the tarsal joints short, broad, and more or less dilated on their sides. We look upon these organs, in fact, as only extreme modifications of the same primary structure, just as that which we see in the tarsi of [illegible] *Leptura* and a *Cicindela*; these latter being both cursorial, or adapted for running. Many of the *Cerambycidæ*, again, live on decomposed or dead wood, either in their larva or perfect state, or in both; and all the *Scarabæidæ* subsist upon decayed or decomposed vegetable matter: the colours of both are dull or dark, and they are equally tardy and heavy in their motions. In short, the parallels between these two typical divisions are as strong as the nature of the case can possibly admit; nor are there wanting instances where the lamelliform antennæ of one is seen in a much greater degree of developement than in the tribe where this structure is universally prevalent. On the analogy, or rather the affinity, between the *Prionidæ* and the *Lucanidæ* we have already stated quite sufficient; as well as on those reasons which makes the *Buprestidæ*, however obscurely, the representatives of the *Curculionidæ*. As for the last in our series, wherein the *Bostrichidæ* stand opposite to the *Hydrophilidæ*, the same uncertainty exists in this as in the preceding table. If Latreille's *Sagrides* really fill this station, our difficulty would be removed, since those insects present two tangible points of analogy both to the *Hydrophilidæ* and the *Dyticidæ*; one, in the great developement of their posterior legs, and the other in their aquatic habits. Latreille remarks that the *Donaciæ*, in their larva state, live on the internal parts of the roots of those aquatic plants upon which the perfect insect feeds; so that in their larva state they are as decidedly aquatic as any of the true water beetles. On the other hand, these analogies may be all perfectly true, and yet the *Sagrides* may hereafter prove to be no other than some aquatic type within the circle of the *Monilicornes*, and as such, also, we shall subsequently treat them.

(254.) Our first family, the PRIONIDÆ, contains, as we have before observed, many of the most gigantic of the *Coleoptera*. As the term is rather indefinite, a distinct idea will be conveyed, when we say that the *Titanus gigas* is frequently eight inches long, exclusive of the antennæ; and the *Prionus Hayesii* of Mr. Hope, evidently closely allied to the genus *Macrotoma*, is four and a half inches in body, but, including its antennæ, it is nearly a foot long. There is considerable variation in the structure of these organs in the family before us: that which is most typical, and which occurs chiefly in the genus *Prionus* itself, is to have them pectinated; although in the larger genera, as *Titanus*, *Enoplocerus*, *Ctenoscelis*, &c., they are filiform: but it must be observed, that what is technically called serrated arises from the gradual enlargement from base to apex of each successive joint of the organ, and not from the armature of the joints themselves; in which case *Enoplocerus*, *Macrotoma*, and others, would also have serrated antennæ, as each joint is thickly set with minute teeth. In *Polyarthron* they are flabellated, and consist of forty-seven joints; whereas, as we have before had occasion to observe, the typical number, as that which most constantly occurs, is for the organ to consist of but eleven. We however find in this family frequent aberrations in this particular, as very many exceed the usual number. Its most elegant form is that, perhaps, which occurs in the imbricated antennæ of the males of *Prionus;* and the family has received its name from this serrated structure, *prion* signifying a saw. Other parts, besides the antennæ, are likewise thus singularly furnished, especially the legs and sides of the thorax; the latter being always armed, laterally, with one or more spines, and frequently with a row of very minute and sharp teeth; and it is from the variation in the number and arrangement of these spines and teeth, that Serville has founded his distribution of the large mass they constitute, and has thence broken them into genera. We have adverted to the characteristic of their being usually dark and sombre insects. This must not, however, be adopted with a rigorous application; nor can, indeed, any character universally in any group in nature; for here, even in *Megopis*, *Anacantha*, and *Cœlodon*, the thorax is not denticulated; in *Mallodon*, and many others, the legs are not serrated; in *Anacolus* and *Pœcilosoma*, the body is gaily coloured; and in *Pyrodes*, *Psalidognathus*, and *Cheloderus*, it is brilliantly metallic: the latter is remarkable for its concave, small thorax, and is an extremely rare insect from Mexico, whence also *Psalidognathus* comes. There is considerable difference in the sexes of the latter; and, as in most metallic insects, differences of colour, some being of a deep blue, and others of a bright green; whereas *Cheloderus* is of a rich vinous tint. The leading instance of analogy to the *Lucanidæ* is found in the deflexed, elongated, forcipate mandibles of the former; but the largest developement of this structure is in *Macrodontia*, where they are greatly porrected, and more than twice as long as the head. These insects fly usually at night, and during the day they are lazily affixed to the trunks of trees. The power of flight, of course, implies the possession of wings; but one genus (*Prionapteron*) is remarkable for being apterous, and having its elytra soldered together. In *Anacolus* these organs are shorter than the body and the true wings; and, although the tetramerous tarsal structure is universal among them, yet in *Trictenotoma* they are heteromerous; whence M. Solier has combined it with *Phrenapates*, another anomalous genus, but belonging certainly to a different group; and he has formed with them an introductory section to his distribution of the *Heteromera*. We, however, think *Trictenotoma* appears to have a strong affinity to the *Lucanidæ*, into the circle of which, as an aberrant form, it ought possibly to enter; of which we have a double indication in the structure of the antennæ, which present a very elongate basal joint, and an indication of a lamellated form at the apex. A similar situation might also, possibly, be assigned to *Parandra*, which the majority of systematists have placed contiguous to the *Prionidæ*; in their general form, however, particularly in that of the clypeus and labrum, and the thorax, and in the possession of the tarsal plantula and pseudonychia, they are closely related to the *Lucanidæ*, and only want pectinated antennæ to belong absolutely to that family. But leaving this for future investigation, we have not the least doubt that, by means of the extraordinary *Tornentes*, a South American insect, nearly three inches long, and not more than half an inch broad, we have a direct intimation of the proximity of *Cucujus* and its affinities, as *Spondylis* equally points to the sub-family of the *Bostrichidæ*. The excessively flattened forms of *Cucujus*, *Brontes*, *Dendrophagus*, &c., is admirably adapted for their peculiar economy, living, as they do, beneath the bark of trees. The allied *Palæstes* and *Passandra* follow naturally here, where we think it probable that *Clinidium, Rhysodes*, and *Cupes*, also associate; indicating another affinity, in the direction of *Brenthus*, amongst the Curculios. Within this circle, possibly, also, but certainly its most aberrant sub-family, may we place the remarkable *Paussidæ*, — insects that sport with the integrity of all previous systems, and present a problem, as to their relations, never yet satisfactorily solved. Indeed, the small lignivorous and fungivorous genera of coleopterous insects are far from having yet been lucidly investigated, or even an approximation made to their affinities and analogies. The *Paussidæ* not only exhibit a very heterogeneous structure in their antennæ, all the species differing considerably *inter se* in their form; but they present, likewise, an extraordinary difference in the number of the joints of these organs in the several genera of which the sub-family is formed: thus, in *Cerapterus* there are ten, in *Pentaplatarthrus* there are six; in *Paussus* two, the terminal joint being usually variously swollen and denticulated; but, as if Nature took here a particular pleasure in extraordinary freaks, we have even one in which this joint is perfectly cylindrical. Their legs present similar anomalies, for some are much compressed and dilated, and others are likewise cylindrical. [W. E. Sh.]

(255.) The *Cerambycidæ*, according to the views already explained, form a family group, in which the front of the head, when viewed in profile, is always more or less vertical. This singular formation, which, as a general character, is found in no other family of the capricorns, is almost essential to the economy which belongs to the whole of this group. Sufficient evidence is before us, that the manners of *Lamia amputator*, first made known by Guilding, are more or less similar to its numerous congeners: for some purpose, which is not yet sufficiently cleared up, these beetles are in the habit of gnawing off the branches of trees; and this is done in such a manner that they appear to be cut off, in an abruptly transverse direction, as if by the strokes of an axe or hatchet. Now, to accomplish this, it is evident that the head of the insect should be considerably bent downwards, that the jaws may cut transversely instead of obliquely. Hence we find, that as stooping the head during this long and toilsome occupation would have been exceedingly wearying to the insect, nature has given to that part a permanent position most suited to the office it has to perform. By this, also, we see the necessity of great muscular power being placed in the jaws, and the consequent enlargement of the head: the compact manner, also, in which this part is joined to the thorax, which, by encasing a considerable portion of its base, gives it still greater strength, is likewise in unison with the economy belonging to the family before us; and is strikingly opposed to the small exserted heads of the *Prionidæ*, and the feeble structure so characteristic of the *Lepturidæ*. We select this, therefore, as the primary character of the *Cerambycidæ*; for it not only pervades the typical, but, with a very slight diminution, all the aberrant groups. When to this we add the equal breadth of the thorax and the head, the shortness and breadth of the tarsal joints, and the slight degree in which the hinder legs exceed the others, we enable the most unpractised student to determine at once, without minute anatomical investigation, the insects before us.

(256.) Our analysis of this family has not proceeded sufficiently far to allow of our designating more than the five sub-families, and to offer some remarks upon what appear the typical genera. We arrange the whole in the following divisions: — 1. The *Acrocininæ*, which, as representatives of the *Prionidæ* (with which, indeed, they were once placed), are of a very large size; having the body considerably depressed, the anterior feet much lengthened, and the elytra spined at their tips: the tarsi in this group are very peculiar, and depart considerably from the typical structure; the first joint is nearly as long as all the others, and the third only is lobed, or heart-shaped*: nor is there any "knob or swelling like an articulation, at the origin of the last," or claw-joint; hence we infer that these insects are much more cursorial than any of their congeners, since their tarsi have a close resemblance to those of the *Lepturidæ*.—2. The *Lamiinæ*, where the typical characters of the family are most conspicuous, appear to follow the last. Their body is narrower, more cylindrical, and does not much exceed the breadth of the head and thorax; the front of the former is so broad and flattened, that it is almost square; and the latter is almost always armed with spines or tubercles. As they walk very slowly, but cling tenaciously, their feet are very different from the last: in the great majority, the two first joints are very short and heart-shaped, and the third, as usual, deeply lobed. In some, approaching to *Acrocinus* Ill., the anterior tarsi are greatly dilated in one sex, and conspicuously fringed with hairs: few are ornamented with any bright colours, and none that we know of are metallic.—3. The *Cerambycinæ* have a general resemblance to the *Lamiinæ*, in their cylindrical body being nearly of equal breadth throughout; but their thorax and head are somewhat narrower, their legs more slender, and the first tarsal joint rather longer than the next: the appearance of these insects, also, is quite different; their elytra are smooth or glossy, and often ornamented with a beautiful admixture of colours. One (*Lophonocerus*), from Brazil, covered with bright yellow spots upon a black velvet-like ground, is one of the most elegant capricorns of this family.—As a type of the 4th division, we place the genus *Lissonotus*, which seems to intervene between this sub-family and the next. These insects are remarkable for their large frequently tuberculated, and wrinkled thorax, and the comparative smallness of their head, which is scarcely vertical. The antennæ are very long, and the joints in one sex considerably compressed and widened as they approach their termination. Thus, with the robust form and general structure of the feet of the *Lamiinæ*, they begin to put on the characters of the *Lepturidæ*; and here, therefore, do we consider the two are united.—On the 5th type we feel incompetent to speak with any degree of confidence. The *Saperdæ* Fab. are too closely allied to the *Lamiinæ* to be separated as a distinct sub-family. We have seen in museums certain South American *Cerambycidæ* having flabelliform or laminated antennæ (*Phœnicocerus*); but without the power of examining them at this moment, we dare not venture to say how far they are related to *Lissonotus*, or whether they form a distinct group which would come in as the most aberrant division of this family. Judging theoretically, we should consider this latter supposition more than probable; since such a form is obviously analogous to *Melolontha*, *Elater*, and several other types, filling the most aberrant stations in their own circles. Their shape, also, assimilates very much to certain pubescent *Prionidæ* from South Africa; and thus they may connect the *Lissonotinæ* with the *Prionidæ*. These, however, are mere conjectures, useful perhaps in directing the attention of others to the subject, but by no means sufficient to influence their decision on so intricate a point: yet, for the present, we shall consider *Dorcadion*, *Parmena*, and their affinities, as occupying this situation.

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* This is one of the innumerable instances of abuse of primary characters drawn from these organs. Authors begin their definition of this family by stating that the second and third tarsal joints are heart-shaped, and the last with a knob at the base, whereas all the three are diversified in almost every leading group.

(257.) Hasty and imperfect as the foregoing sketch of this family may be, it is quite sufficient to show there is a mutual relation between those divisions we have characterised, and those belonging to other assemblages. This will be apparent on looking to the

Analogies of the CERAMBYCIDÆ *and the* CAPRICORN FAMILIES.

Sub-families of the CERAMBYCIDÆ.	Analogies.	Families of the *Capricornes*.
Lamiinæ.	Antennæ excessively long; typical of their respective groups.	CERAMBYCIDÆ.
Cerambycinæ.	Antennæ moderately long; sub-typical; form more slender.	LEPTURIDÆ.
Lissonotinæ.	Thorax very large and much developed; head small.	BOSTRICHIDÆ.
Dorcadioninæ.	Antennæ remarkably short; often apterous.	CURCULIONIDÆ.
Acrocininæ.	Size large; tarsi sub-cursorial.	PRIONIDÆ.

Without dwelling upon all these resemblances, it may be sufficient to remark that *Lissonotus* offers a striking analogy to *Bostrichus*, in the enlargement of its thorax, the comparatively diminutive size of its head, and its short feet, — circumstances which appear to favour our idea, not only that the two groups are analogous (for that is sufficiently obvious), but that they naturally stand in the situation of affinity we have assigned them. A few details on each of these sub-families, and of the general principle which appears to enter into each, will conclude our remarks on this division of the capricorns.

(258.) The *Acrocininæ*, although mostly large, are few in number, and are chiefly, if not exclusively, confined to Tropical America. The *Acrocinus longimanus*, Lacordaire informs us, is usually found upon the trunks of trees or near them, and that it rarely occurs beneath their bark; it has an awkward gait, and drags itself along rather than walks. It sometimes takes flight about nightfall, and this it accomplishes heavily, but with a considerable noise. It seems scarcely capable of directing its progress, as it frequently strikes against trees, and then falls to the ground. It possesses the power, like many other *Coleoptera*, especially *Capricornes*, of producing a loud and sharp noise by the friction of its thorax; and this can be heard at a considerable distance. It is asserted that the umbones, or movable spines upon the thorax of these insects, have no use; this is merely a confession of ignorance, for is it at all probable that such an apparatus should be formed for no purpose? We strongly incline to the opinion of Messrs. Kirby and Spence *, who "hazard the conjecture, that these organs were given to this animal by an all-provident Creator, to enable it to push itself forward, when, in the heart of some tree, it emerges from the pupa, that it may escape from its confinement." The great length of its legs, and from their being folded beneath it, and the confined position it is in, render a provision of this kind essentially requisite. *Macropus*, *Oreodera*, *Micropsia*, &c., enter into this sub-family.

(259.) The *Dorcadioninæ* are apterous insects, which sometimes have the elytra soldered together. They chiefly occur upon the ground in sandy districts, and are abundant in the South of Europe, especially on the coasts of the Mediterranean; others occur at the Cape, and a very few come from the Brazils. These insects have usually an elliptical body and short antennæ, and are slow and heavy in their motion: they are usually also of small size. *Parmena*, *Dorcadion*, and *Morimus* constitute the most typical forms, and *Phrissoma* and *Ceroegidion* appear more aberrant: the latter are peculiar to the southern hemisphere. The *Lissonotinæ* comprise *Megaderus*, *Trachyderes*, and other allied genera. They are generally gaily marked insects, and are chiefly natives of South America: their elytra are usually smooth and shining; and frequently their thorax is very considerably tuberculated, and the body somewhat depressed and attenuated posteriorly. A common characteristic of the *Capricornes*, the elongation of the male antennæ, is found considerably developed amongst them. The genuine *Cerambycinæ* constitute but a small group, and the typical genus is confined to the old world, where, however, it has a wide distribution, occurring as far

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* Int to Ent., iv. 587.

eastward as the Philippine islands. The *Lamiinæ* form a very large group, and range all over the world. They possess great variety of form, and amongst them are found some of the most eccentric of the entire circle. They are rarely metallic, and their prevalent colours are greys and drabs; their anterior tarsi are frequently considerably dilated, and their antennæ have occasionally a horny hook at the extremity. Some of the most remarkable genera are *Gnoma*, with its greatly elongated neck, and the terminal joints of its antennæ, forming segments of a circle; these are natives of the larger islands of the South Pacific Ocean: then *Tapeina*, in which the head is considerably flattened in front, and produced into a lateral plate, behind which the antennæ are inserted; *Trachysoma*, with its humped camel-like back; and *Xylorhiza*, which has all the appearance of a piece of dead stick. [(258, 259.) W. E. Sh.]

(260.) The third, or sub typical, family of the capricorn beetles are the *Lepturidæ*, known at once by their slender form, their small and slightly exserted head, which is triangular in front, and by their cursorial legs; the hinder pair of which are more or less lengthened. The most universal character, probably, among these insects, is the prolongation of the first tarsal joint, which is equal in length to all the others, particularly in the hind legs; the second joint, also, is not heart-shaped or dilated, but more properly resembles the sides of a wedge: the head is narrower than the thorax; and the eyes are generally oval, instead of kidney-shaped. The profile of the head, no longer vertical, is directed obliquely forward. Under this family we include most of Latreille's restricted genus *Cerambyx*, together with all the other floral capricorns, as *Leptura*, *Clytus*, *Necydalis*, &c.

(261.) The great majority of these elegant insects, remarkable for their vivid colours and slender form, may be naturally arranged under the following subfamilies: — 1. The *Stenocorinæ*; where the body is cylindrical, convex, and of equal breadth throughout;

the thorax ventricose, and the elytra abruptly terminated by two acute spines, similar to those of *Acrocina*. — 2. The *Callichrominæ*, where the body and elytra are narrowed from the base. — 3. The *Lepturinæ*, greatly resembling the last, but head narrow and porrect at the base: the thorax, also, is narrow in front, and is only spined in one or two types. — 4. The *Necydalinæ*. — And, 5. The *Dasycerinæ*, where the general form is not unlike that of *Stenocorus*; but the elytra are not spined; the thorax and head are of equal breadth with the body, and the former, in the typical genera, is considerably lengthened; the thighs or shanks are nearly all clavate, or suddenly thickened at their outer extremity: and the aspect of very many immediately reminds us of the *Saperdæ* among the *Lamiidæ*. Looking to them as forming a circle, we shall at once arrange them in the following series, for the purpose of determining their analogies in other groups.

Analogies of the LEPTURIDÆ *and the* LAMIADÆ.

Sub-families of *Lepturidæ*.	*Analogies.*	Subfamilies of *Lamiidæ*.
CALLICHROMINÆ.	Sub-typical.	CERAMBYCINÆ.
LEPTURINÆ.	Pre-eminently typical; destitute of metallic colours.	LAMIINÆ.
NECYDALINÆ.	Thorax considerably enlarged, and ventricose	LISSONOTINÆ.
DASYCERINÆ.	Thorax cylindrical, unarmed, and very long.	DORCADIONINÆ.
STENOCORINÆ.	Elytræ terminating in acute spines.	ACROCINÆ.

(262.) The only confidence we feel in this table, results from the analogies which appear to exist between the respective groups; and in a conviction that the two series are naturally distinct. But our analysis has not proceeded sufficiently far to determine the rank either of the *Dasycerinæ* or the *Dorcadioninæ*: we believe they are representatives of each other; and as such we have placed them, provisionally, as sub-families. This analogy may yet hold good; even if the groups themselves turn out, upon further examination, to be of different or subordinate ranks.

(263.) The *Stenochorinæ* present us with some very interesting genera. In addition to the spines of the elytra, the apex of the joints of the antennæ are frequently prolonged into acute spines, as are also in some the extremity of the femora. *Uracanthus* is distinguished for its narrow very linear form, and *Scolecobrotus* for the series of small spines occupying the whole length of each joint of the antennæ externally; and *Eburia* and *Elaphidion* are gay insects with ivory-coloured spots; but *Chlorida* is distinguished for its pale green elytra.

(264.) The *Callichrominæ* are very elegant insects, usually of brilliant greens and blues, and are frequently of very conspicuous size, especially in the genus *Callichroma* itself, in which the posterior tibiæ are always compressed into a dilated plate. The type of the sub-family is a British insect, namely, the *Aromia moschata*, which, like its congeners, as also the species of *Callichroma*, exhale a rich fragrance much resembling the odour of the otto of roses. This is produced by a white milky secretion more liquid than what we have observed in speaking of the exuding secretion of *Meloë*. Possibly here, the fluid is a sexual lure instead of a means of defence, as it is always found to be strongest prior to their intercourse. *Ionthodes* and *Rosalia* are also elegant insects, and the latter is extremely abundant in various parts of Switzerland: the majority of these occur in humid situations, and chiefly inhabit soft wood like the willow.

(265.) The LEPTURINÆ are distinguished from all the rest of the *Longicornes* by their very distinct neck, which in some, as in *Nemotrogus*, a large linear Cape insect, is extremely long, as are also the antennæ, the latter being very slender. The thorax attenuated in front, amply characterises this sub-family, and, together with their porrect mouth, gives them a peculiarly inquisitive appearance. They are usually very agile, and frequently gaily coloured: this is conspicuous in *Leptura*, *Toxotus*, and *Strangalia*; whereas in *Rhamnusium*, *Rhagium*, and *Cometes*, the legs are short and their gait is heavy. They are frequently found upon flowers and the trunks of trees, and many species are natives of this country. The other sub-families are noticed below. [(263—265.) W. E. Sh.]

(266.) On the sub-family *Necydalinæ* we shall venture more at large. After our first theoretical arrangement of the *Capricornes*, we selected this group for minute analysis, with the object of ascertaining how far the result would demonstrate the accuracy of our general distribution of the whole tribe. As we have already explained the distinguishing characters of this group, it will be only necessary to impress upon the reader its true typical perfection. The *Necydalinæ* represent the *Malacodermes*, or soft-winged beetles, in the family of floral *Capricornes*, precisely the same as do the *Staphylinidæ* in the tribe of *Predatores*, —with which, in fact, it is naturally analogous. Now, the great peculiarity of the *Malacodermes* and the *Staphylinidæ* is this, —that the elytra are soft, and much less developed than in any other type: hence it follows that, as the *Necydalinæ* represent these two groups, those forms which have the most imperfect elytra become the most typical. They are, in short, pre-eminently imperfect in that particular structure, which distinguishes the *Coleoptera*. The genus *Necydalis* of Linnæus accordingly stands at the head of this sub-family, because, of all those forms which compose it, these have the shortest and the most imperfect elytra.

(267.) The general aspect of these insects, particularly when alive, and running upon flowers, so closely resembles that of the hymenopterous sand-flies (*Sphecidæ*) that even an entomologist is often deceived at the first glance. The wing-cases are so short that the true wings are exposed; and these, unlike most other beetles, have no transverse fold, but lie upon the long, somewhat pedunculated, body, at their full length. The true *Necydali* and the *Sphecidæ* frequent the same situations; both are fond of basking in the sun, and feeding upon the nectar of umbelliferous flowers; and they may often be captured from the very same plant. Their active gait shows that their structure, like that of all the floral *Lamellicorner*, is adapted for running. We consequently find the hinder legs remarkably long, while the basal tarsal joint is double the length of the two next. The most remarkable developement of this singular form of beetle, is seen in the *Necydalis major* Linn., the European type of the genus, at once distinguished by its very short and abruptly truncated elytra. Other sub-genera occur in Tropical America; one having the thorax globose, the hinder legs hairy, and the elytra more lengthened and pointed: the other has the thorax cylindrical (*Odontocera*), more like the European type, but the tapering elytra are nearly as long as the body: in both these American types, the thighs are considerably and suddenly swollen.—We pass on to the next or sub-typical genus, *Vespisoma* (*Vesperus* of the French catalogues), where we have the general form of a *Necydalis*, but with the body shorter, and almost entirely covered by two very narrow elytra,—so narrow, indeed, that the whole body does not exceed the breadth of the thorax. Nature seems to have a peculiar pleasure in representing her forms under appropriate disguises; for here (*Clytus*) we have beetles clothed in the very colours of bees and wasps,— that is, banded and spotted with bright yellow upon a dark ground: the head is short, broad, and abrupt; and is so much encased in the large globose thorax, as to appear confounded with it. These, like the *Necydali*, are frequently found upon umbelliferous flowers; and, under several sub-generic forms, are common both to temperate and tropical countries. The three aberrant genera appear to be represented by *Distichocera* Kirby, *Euryptera*, and *Cleonia*. In regard to the Australian *Distichocera*, however, we cannot speak from personal observation. Mr. Kirby, whose idea we have adopted, expressly mentions its affinity with *Necydalis*, and its analogy to *Rhagium*; and it will be found that both these opinions are verified by the attempt we shall now make to illustrate their analogies.

Analogies of the NECYDALINÆ *with the* CAPRICORN FAMILIES.

Genera of the *Necydalinæ*.	*Analogies.*	Families of the *Capricornes.*
NECYDALIS.	Head prominent, porrect.	LEPTURIDÆ.
CLYTUS.	Head obtuse, the base incased within the thorax, front vertical.	LAMIIDÆ.
DISTICHOCERA.	Thorax large, globose.	BOSTRICHIDÆ.
CLEONIA.	Body lengthened, cylindrical.	CURCULIONIDÆ.
EURYPTERA.	Mouth and jaws prominent.	PRIONIDÆ.

(268.) It is a remarkable circumstance, that one of the most universal distinctions between the floral and the lignivorous capricorn beetles, namely, the different insertion of the head, is likewise conspicuous in the smaller group. *Necydalis* and the *Lepturidæ* feed upon flowers: they are, in their respective stations, pre-eminently typical; and both have the head distinctly projecting beyond the thorax. On the other hand, we see, that as *Clytus* represents the *Lamiidæ*, it accords with these latter insects in several respects: it is more fond of wood than of flowers; its structure is more robust; and the head, like that of a *Lamia*, is so much sunk in the thorax, that there is no indenture between the two parts. Compare the remaining three genera, again, with the aberrant families of the tribe, and the series of analogies follow in the same order. *Distichocera* is remarkable for its large globose thorax; so also is *Bostrichus*. The most lengthened and slender beetles in existence are found among the *Curculionidæ*; while *Cleonia*, in just the same manner, is the most lengthened and cylindrical of all the aberrant *Necydalinæ*. But still we want another genus to complete the circle; and this, from all we know of the natural series in other groups, should have exserted jaws, in order to represent the *Lucanidæ*, the *Prionidæ*, the *Staphylinidæ*, and their corresponding types: no genus of modern systems appears to possess these characters more than *Eurypter a*, a very curious insect we found in Brazil; its jaws are not, indeed, very decidedly exserted, but the mouth is considerably produced: we are further disposed to assign it this station, because it clearly represents *Hispa* and *Lema*, which seem to occupy the same station among their congeners as *Eurypt era* here falls into in the sub-family of *Necydalinæ*. On looking among the other *Lepturidæ*, for representations of *Eurypter a*, we are immediately struck with its outward similarity to *Stenoderus*, in the shape of its elytra; while the beautiful parallel between *Distichocera* and *Lissonotus* is one of those resemblances all can perceive. So far as our analysis has yet extended, the sub-genera of *Clytus* and *Necydalis* are in unison with this series of the genera of *Necydalinæ*.

(269.) We have frequently called the attention of zoologists to a singular fact, which the structure of *Distichocera* fully confirms. In the rasorial type (or that which corresponds to it among insects), the antennæ are either greatly developed, or are of an unusually complicated structure. The tribe of the *Capricornes*, which represents the rasorial tribe of birds, are accordingly remarkable for the excessive length of these members. In like manner, as *Distichocera* represents these tribes in the little circle of the *Necydalinæ*, so do we find it is distinguished from all the remaining genera by the very same circumstance, — namely, the peculiar developement of its antennæ. The great prevalence of this structure is again seen in the tribe of *Bombycidæ*, or the silk-worm moths, where the antennæ are very highly developed; while, in the very smallest group in nature, we have a sub-genus of *Necydalis* where the antennæ appear as if borrowed from a *Bombyx*. It by no means follows, however, that *all* rasorial types possess pectinated, or very long antennæ; because, if so, the bulky *Dynastidæ* should have longer antennæ than any of the other *Lamellicornes*, which they have not: but here we find the same analogy manifested under *another* character. Rasorial types are pre-eminently horned, or furnished with crests or tubercles, representing the real horns of ruminating quadrupeds. It is therefore under *this* form that nature shows us which is the rasorial type among the *Cetoniadæ;* and nearly every entomologist who has mentioned these singular and unwieldy beetles, has compared them to horned cattle. All the leading types of nature are to be known by some three or four peculiar characters; but as we recede from the highest point of perfection, some one or more of these will gradually disappear: it therefore inevitably follows, that there are comparatively few instances which show a combination of *all* the typical characters; because, in every group, the typical examples are much fewer than the aberrant. Hence a rasorial type may be indicated by the possession of horns, without any unusual development of the antennæ, as is the case with the *Dynastinæ* and the *Megasominæ*. If both these characters are wanting, nature confers upon the type some other of the rasorial characters,— namely, an unusually long neck, as in the *Camelopardalis*, the swan and ostrich among birds, and *Agra* and *Casnonia* among the predaceous beetles. If none of these indications of the rasorial type are seen, nature is still consistent; for she ornaments her type with ocellated or rounded spots, in imitation of the peacock — that bird which stands at the head of the *Rasores*, and in which she has consequently concentrated *all* the rasorial characters in the highest perfection. These remarks, although introduced to illustrate the genus *Distichocera*, must be considered as applying to all natural groups throughout the animal kingdom.

(270.) We shall conclude with a few remarks on the genus *Euryptera*. Most entomologists, upon a hasty glance, may be tempted to look upon this as a very anomalous form, whose admission among the *Necydalinæ* appears extremely doubtful. A more attentive examination, however, will weaken, if not entirely remove, the doubts. In the first place, the very peculiar structure of the antennæ is a strong indication of this affinity; secondly, it is the only form yet discovered in this sub-family, wherein the mouth and jaws are lengthened and prominent. Theoretically, we have abundant evidence that such a form is to be found in every natural genus; because, without it, we should have no representation of the *Prionidæ* and their corresponding types. Now, the mouth of *Euryptera* assumes all the lengthened pointed appearance of that of a bee; while the proximity of the antennæ, and the wide termination of the elytra, remind us immediately of *Hispa* and of *Lycus*,— two groups which, in their own circles, occupy exactly the same station as that we have assigned to *Euryptera* among the *Necydalinæ:* these reasons appear to us much more weighty than others, by which it may be urged that *Eurypterus,* from its lengthened muzzle, is more likely to be the type of the *Curculionidæ*. If we had to look only to this consideration, the analogy is certainly strong; but how then are we to account for the depressed form of the body, and the dilatation of the elytra? The *Curculionidæ*, and all their representations, the *Trogidæ* and the *Melolonthidæ*, are eminently thick and convex; the resemblance, therefore, does not seem sufficiently strong. If an analogy is true, the whole structure of an insect can be illustrated; for, by comparing it to numerous others, all holding the same station in their respective circles, we get an insight, by every fresh comparison, explanatory of some one or other of its peculiarities. What other sub-genera belong to *Euryptera,* we know not; but a very remarkable type, which we here delineate, appears to connect it with the *Lepturinæ*.

(271.) In thus attempting, in some measure, to indicate those principles upon which the two typical families of the *Capricornes*, as we conceive, are naturally distributed, we feel how much remains to be accomplished. Our views, as it will be readily perceived, are completely at variance with those who have gone before us; and yet they have every appearance of coinciding with every thing that we have hitherto written upon the natural system. Thus encouraged, we have had less scruple in giving them to the public; and we hope it may be instrumental in breaking up the present disjointed and empirical mode of studying animals, and more particularly insects: our great object will then be accomplished.

(272.) A few remarks upon the group we have provisionally called *Dasycera* will close our present sketch of these capricorns. They (*Cosmisoma*, *Coremia*, *Disaulax*, &c.) are commonly termed, by collectors, *bottle brushes*, from the circumstance of a considerable number having fascicles, or tufts of hairs, situated about half way on their antennæ, and sometimes, though rarely, on their hinder feet. These appendages, however, are sometimes found in certain insects, which in all other respects belong to the *Lamiidæ*; while in many of those which seem naturally situated among the *Lepturidæ*, there are great differences in all other parts of their structure. Nothing but analysis, therefore, will determine whether these resemblances are relations of analogy or of affinity. In the mean time, however, we cannot resist the belief that, between the *Stenocorinæ* on one side, and the *Necydalinæ* on the other, a large portion of these insects will intervene, and constitute the most aberrant sub-family of the floral capricorns. Those which appear to us the most typical, have the thorax cylindrical, nearly half as long as the body, and always smooth; the head small, truncate, and sunk; and all these three parts are nearly of equal breadth throughout. In this respect, they considerably resemble the *Saperdæ*, but in all other points are totally different. The legs are slender, thighs very clavate, and the first tarsal joint lengthened: the elytra are truncated and unarmed; but, in such as show an affinity to the *Stenocorinæ*, they are spined; while in others, which remind us of the *Necydalinæ*, the thorax is short, broadest in the middle, and the short antennæ much resemble those of *Necydalis*. It is upon these considerations we ground our belief that the *Lepturidæ* form a natural circle of affinity; and that the *Dasyceræ* correspond, in their own group, to the *Saperdæ*, whatever their respective ranks may be. There is an objection, however, against this location of the *Dasyceræ*, on the score of analogy, which, as few will anticipate, we shall ourselves mention. If the thorax of insects be urged by some as representing the neck of quadrupeds (a position we cannot admit), then it may be said there is no analogy between the *Dasyceræ* and the swan, the giraffe, and other long-necked *Vertebrata*, because these are rasorial types, and not the most aberrant. But even admitting this, the long thorax of these insects find their representatives in *Brentus*, among the *Curculionidæ*, and even in a whole order of birds; for the *Grallatores*, or waders have the longest necks, as an order, of all others. However this may be, apparent affinities must not be disturbed for the sake of such abstruse questions as these, which may be safely put aside until natural affinities are better understood — at least, among the *Annulosa*

(273.) Our fourth family, the *Bostrichidæ*, although of comparatively limited extent, is of a very marked character; and also, although possessing considerable habitual resemblance, especially between the typical and least aberrant forms, yet in particulars differ much from each other. The most typical structure is for the head to be retractile within the thorax, which is large, subglobose, and forms a ventricose hood; the body itself is cylindrical. In the most normal forms, the antennæ are geniculated and clavate at their extremity, the knob being sometimes solid. In some genera, as in *Hylurgus*, *Hylastes*, *Scolytus*, the head is prolonged, anteriorly, into a truncated snout; but in *Tomicus*, *Platypus*, &c. it is obtuse; in the latter genus, the tarsi are very long and slender, exceeding the tibiæ in length. In the closely allied genus *Tesserocerus*, the basal joint of the antennæ is continued, in the male, considerably beyond the geniculation of the organ, and this process is dilated at its apex into a fornicate appendage with a long fringe, and, in repose, the two combined meet over the forehead and cover it like a cap. In *Tomicus*, the elytra are frequently retuse at their apex.[1] The little *Scolytus* is notorious for the devastation it has caused among the elms in the vicinity of the metropolis, but it is a point not yet quite satisfactorily decided, if it is the insect which is the original depredator, or whether, from some other cause, the tree having fallen into a sickly condition, these insects then visit it, and greatly accelerate its total destruction. The majority of this family are sub-cortical dwellers, comparatively few of them piercing into the solid wood. Almost every species has a different mode of forming its gangways, and in some cases the channels they elaborate are extremely elegant. Between these, which have the closest affinity to our next family, and *Bostrichus*, *Apate*, &c., the chief and most marked differences consist in the clava of the antennæ being formed of three distinct and separate joints: there is a great difference also in their larvæ; those of the latter, where, indeed, the structure of the antennæ has a lamellated indication, being considerably like those of the *Lamellicornes*, and have long legs, whereas the former are apods, or have but warty tubercles. Those of *Apate*, &c also more frequently bore into the solid wood of trees. In *Anobium*, and its immediate allies, we observe the antennæ becoming filiform, the only intimation of its preceding structure consisting in the elongation of the three terminal joints, which sometimes, as in *Dryophilus*, exceed the length of the remainder of the organ. We thus detect an indication of the proximity of *Ptinus*, in which, however, there is a departure from the xylophagous habits of the group, pointing evidently towards *Dermestes*, whence we doubtlessly come into close contact with the circle of the *Silphidæ*. By means of *Nemosoma*, and from it through *Trogosita* (for it is here we expect the latter must come, proved by that affinity), we find collateral affinities impinging clearly upon the *Cucujidæ* in the circle of the *Prionidæ*. We have not space here to analyse these relations, and can only hint at them to guide the student's further research. As aberrant constituents of this circle, we shall, of course, find many of the small xylophagous genera, as *Lyctus*, *Bitoma*, &c. &c.

(274.) Our fifth family consists of the *Curculionidæ*. It cannot be expected that we can give more than a very general idea of this enormous concourse of insects, which, in Schönherr's monograph, already occupies five octavo volumes of nearly a thousand pages each, and will possibly require as many more to complete it. The described species considerably exceed 5000 in number. The most striking peculiarity in their economy is their being very extensively carpophagous, or feeders upon seeds and fruits: we have already noticed some of their most prominent features, and thence we may assume that those which have the longest rostra, and most strongly geniculated antennæ, must, of course, be the most typical in their own circle; we therefore find them in the genus *Balaninus*, our common nut weevil, and its affinities. *Megarhinus* and *Antliarhinus* also offer us striking instances of this characteristic; in the latter, this rostrum is several times longer than the body, and as slender as a stout bristle. Schönherr, in his very artificial arrangement of these insects, has widely separated these genera; he has, however, suggested a new arrangement at the commencement of his fifth volume, in which he has turned the whole mass, of what he calls the spurious Curculios, round, to follow the *Orthoceri*, or those which have not the antennæ geniculated, but which are usually long-snouted insects. By this means we have them immediately succeeding the *Cossoni* and *Rhyncophoræ*, insects, also, which have long rostra. The filiform *Brenthides*, as also the *Rhinomacerides*, *Anthribides*, and *Bruchides*, as abnormal forms, are excluded from the genuine series. The most typical *Gonatoceri*, or those with geniculated antennæ, are evidently contained in the first division of his *Mecorhynchi*,— namely, the *Erirhinides*, two forms of which we have already noticed. The position of the legs, the structure and number of the joints of the flagellum of the antennæ, the form of the pectus, of the rostrum, and of the lateral channel in the latter, into which the insect can withdraw its antennæ, supply the leading characters in the generic distribution of this host of insects. Thus, in some, as in the *Cryptorhynchi*, the insect has the power of burying its long rostrum in a groove in the breast. *Zygops*, in this same group, is remarkable for the size and contiguity of its eyes, as also for the compression of its legs, and *Mononychus* for the single claw at the apex of its tarsi. In *Mecopus* the anterior legs of the male are exceedingly lengthy. We also find lengthy anterior legs among the *Rhynchophora*, which have not the power of concealing their long rostrum in the breast. In the latter, the tarsi are considerably developed, and they contain the largest genuine weevils, all being truly carpophagous. *Protocerius colossum* is more than two inches long, and of a proportionate bulk; in length, however, as compared with bulk, the *Brenthides* are the most conspicuous, for *Brenthus barbicornis*, a New Zealand insect, is usually two inches and three quarters long, and at its widest part it is not more than two lines wide: but the most bulky of this group are to be found in the short-snouted division, in the genus *Brachycerus*, wherein we have a species more than an inch and three quarters long, and an inch broad, and all its limbs of a proportionate robustness. These latter insects, which are apterous, occur in sandy deserts, and we have already had occasion to compare them with some of the Pimelias, with which, in habits, they completely agree: they occur in abundance in Southern Africa, Patagonia, and the French coast of the Mediterranean. Apterous insects are very frequent in this group, which also, although it presents very many obscure and black insects, is chiefly remarkable for the brilliant splendour of the majority of its members. A well-known instance of this splendid clothing, and one not easily surpassed, is to be found in the common diamond beetle, *Entimus imperialis*, and its neighbour *E. splendidus*, insects usually so abundant in the Brazils, that the trees which they inhabit — a species of Acacia — are more densely covered with them than with their leaves, and which would thus happily prefigurate the gardens of the Hesperides with their golden fruit, here refulgent with the most delicate and varied tints of gems and metals. *Cyphus* also is very rich in its vestments, yet few surpass the elegant little *Coniatus Tamarisci*, which, upon a golden green ground, has a couple of oblique bands of a bright coppery hue. The colour of these insects, for which we have significantly used the term clothing above, is produced by the imbrication of a multitude of minute scales of a variety of forms, and which under the microscope, for which they prove admirable test objects, exhibit differences of sculpture; and this, from its various reflection of the rays of light, produces all their diversities of tint. Although the colour of the majority of these insects is usually produced by the scales, yet some of intensely brilliant hues are totally without them, as in the genus *Eurhinus*, where we have greens, blues, and purples — the colouring of the integument itself — unsurpassed in the whole circle of the *Coleoptera*: these are smooth insects; but in *Rhynchites*, a softened tone is given to their tints by a multiplicity of minute punctures, whence a lengthy pubescence envelopes the creature. One of the most splendid of the latter is the *Rhynchites Bacchus*, an insect which has derived its specific name from its attachment to the *vine*, which unfortunately, however, it "loves to destroy," for in the vineyards of the Continent it is frequently very detrimental. We are prepared to expect many eccentricities of structure in so large a group of insects, and of which we witness on all sides remarkable exemplifications: the thickened snout of *Hipporhinus*; the two curved spines of the propectus of *Diorymerus*, as also its humped thorax; the remarkable obesity of *Guiopterus*; the conspicuous central strangulation of *Hyphantus;* the tabular flatness of *Homalonotus;* the spinose and tuberculated backs of many *Hipporhini* and *Amycteri*, and the very obtuse snouts of the latter; as also the gibbous forms of *Byrsops;* the thickened antennæ of *Ulocerus* and *Episus;* the remarkably slender antennæ of a small new genus from Van Diemen's Land, in which these organs are longer than the body; and *Eurhamphus*, one of the largest of this group, which has its body covered with scattered tufts of erect brown and white hair, — all offer striking instances. Being chiefly phytophagous insects, — for *Brachycerus*, and some few others, form remarkable exceptions — they are, of course, the natives of all countries; and the more luxuriant vegetation becomes, the greater is their population, which is strongly confirmed by their abundance in the Brazils. It is chiefly from the aberrant portions of this large group, that we trace their more direct affinities; thus, by means of *Rhinomacer*, we have a passage marked towards *Mycterus* and *Salpingus*, in the heteromerous division of our *Malacodermata*, and through *Rhinotia* to *Lycus*, in its pentamerous division. In *Bruchus*, they direct, by their flabellated antennæ, to the *Lamellicornes*, and by their enlarged posterior thighs to *Sagra*, in the monilicorn circle; but it is by *Mecocerus* and *Ptychoderes*, among the *Anthribides*, that we have the most evident affinity indicated with the normal *Capricornes*. Here, also, in the broad short snout of *Euparius*, *Platyrhinus*, and *Lagopezus*, we have an affinity shown with the *Scolytidæ*, in the circle of the *Bostrichidæ*, which is further confirmed in a different part, namely, to *Anobium*, &c., by the serrated clava of *Aræcerus*. If we may venture an analogy with the *Predatores*, we have it hinted at in the lengthened neck of *Apoderus*, which much resembles *Casnonia;* whence Linnæus mistook one of the latter for an *Attelabus*, with which he considered *Apoderus* as congenerical. [(273, 274) W. E. Sh.]

CHAP. IX.

COLEOPTERA, *continued.*

THE MONILICORNES.

(275.) THE MONILICORNES appear a most natural tribe of the *Coleoptera*, when we look only to the chief types; but until those, which we shall here term the aberrant forms, are better studied, their precise situation in the series is rather surmised than asserted. This division is eminently distinguished from the *Capricornes*, both by the habits and form of the larvæ, no less than of the perfect insects. In one sense they are the most typical of all *Coleoptera*, while in another they are the most aberrant; a paradox which may be thus explained: — The whole tenour of our remarks upon this order, when looked at as a whole, goes far to prove that the developement of the superior wings, under the form of hard cases, and great powers of walking, are two of the principal characters of the order. Now, the first of these are more conspicuous among the monilicorn beetles, than in any other tribe; the elytra not merely cover the body in the ordinary manner, but actually, in the typical families, are so much dilated as to project beyond the body, so as to protect the legs; while the thorax, in a similar manner, forms a shield which encircles the head, and completely hides it when viewed from above. These, in fact, are the universal characters of the numerous family of the *Cassidæ*, standing at the head of the tribe; and which, from thus being concealed, as it were, by a buckler over their bodies and joints, are called tortoise beetles. Their inferiority, again, to all other

Coleoptera, is shown in a different way. They have the shortest tarsi of all others, and composed of the fewest joints [*]; they are consequently the slowest walkers. We thus verify our second proposition, of their being the most aberrant of all *Coleoptera*, when viewed in opposition to the *Cicindelidæ*,—the most pre-eminently typical of the order in the powers of locomotion.

(276.) Looking, therefore, to the *Cassidæ*, and their near neighbours, the *Coccinellidæ*, or ladybirds, and the *Chrysomelidæ*, we see a numerous assemblage of small, thick, globose beetles, with the body very convex on the upper part; the thorax nearly as broad as the elytra: the head is always small, either sunk in front of the thorax, or concealed beneath it: the antennæ are moniliform, or resembling a string of beads: the legs are short and thick, with the tarsi dilated and heart-shaped; the first joint of the tarsus, in the typical group, being scarcely longer than the second. Primary characters, however, taken from these organs, in the present group, are absolutely of no value whatever, for they vary in the most remarkable manner in almost every family; nay, sometimes, in the most natural genera. Among these insects, the *Cassidæ* are most remarkable for the singularity of their forms, and the *Chrysomelidæ* for the brilliancy of their metallic colours. MacLeay, looking also to other characters, perceived it was one of the most natural groups in the whole order. He defines it as having "a hexapod and distinctly antenniferous larva, with a subovate, rather conical body, of which the second segment is longer, and of a different form from the others, so as to give the appearance of a thorax." This definition is more especially taken from the larvæ of *Cassida* and *Coccinella*, the two typical families of the tribe. Among the aberrant groups, however, there are several modifications, more or less influenced by their affinity to insects beyond their own circle, and by the analogies they bear to others. The great majority of the *Monilicornes* live upon the leaves of plants; but there is an extraordinary exception in regard to the *Coccinellinæ*, or ladybirds, whose larvæ are carnivorous,—feeding most voraciously, as is well known, upon the *Aphides*, or plant lice. This is another marked instance, within this order, of herbivorous and raptorial insects being actually associated in the same group; and yet, that they follow each other in a natural series, there can be no doubt. This carnivorous propensity seems to be shared also by the *Hispidæ*, but is quite unknown among the larvæ of the other families. Did our space permit, it would not be difficult to show that the ladybirds correspond in their own circle to the predatorial tribe, just as the *Cassidæ* represent the *Lamellicornes*.

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[*] Mr. MacLeay, long ago, completely exposed the artificial nature of the tarsal system (*Linn. Trans.* xv.), by showing, that what the French thought were tetramerous beetles, are in fact pentamerous; and that those which were called trimerous, were actually tetramerous! And yet we find this exploded system taken up again, and called "Modern Classification," because "it is in general use, and of easy application:" so is the binary system of Rennie.

(277.) The three aberrant families which we consider as more or less connected with the two preceding, are the *Clythridæ*, the *Erotylidæ*, and the *Hispidæ*,—each differing, in a striking manner, from the other, both in their larva and perfect state, yet all possessing certain characters by which they approximate to the typical structure. In regard to *Cryptocephalus*, it is impossible to determine, without analysis, whether the insects form a part of the *Chrysomelidæ*, or of a distinct family. The nature of their larvæ, which is stated to be unknown*, might help us to determine this question. However this may be, we have no doubt that the genus *Clythra* is the type of a distinct family, analogous to the *Acrocininæ* by the elongated fore-legs of the perfect insect, and to the *Hesperidæ* by their larvæ: the species are few, and are remarkable for the large size of their heads. The *Erotylidæ* are the largest insects contained in this tribe, and differ so much among themselves, that, from not having been properly analysed, we cannot separate the true from the false affinities. We consider the types, however, to be perfectly distinct from, although strongly resembling in outward appearance, the *Silphidæ* or *Pimelidæ* (the corresponding group in the tribe of *Predatores*); and that the *Stenochiæ* enter herein. Finally comes the genus *Hispa*, as the type of a family, alike distinguished in its larva and its perfect state. By this form, and *Alurnus*, we again reach the *Cassidæ*, and complete the circle of the *Monilicornes* which are here epitomised.

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* Griff. Cuv., p. 146.

Analogies of the MONILICORN *Families.*

Families of the *Monilicornes*.	*Analogies*.	Tribes of the *Coleoptera*.
CASSIDÆ.	Pre-eminently typical.	LAMELLICORNES.
CHRYSOMELIDÆ.	Sub-typical.	PREDATORES.
CLYTHRIDÆ.	Elytra soft.	MALACODERMES.
EROTYLIDÆ.	Most aberrant; tarsi variable	MONILICORNES.
HISPIDÆ.	Larva feeding internally.	CAPRICORNES.

Every principle of analogy drawn from various groups of vertebrate animals, no less than of insects, shows that *Cassida* is the pre-eminent type of the whole tribe; and we have seen that such is also the station of the lamellicorn beetles. *Coccinella*, in fact, although raptorial in its larva, is but a sub-family of the *Cassidæ;* and this station, confirmed by analysis, shows it to be the raptorial division. In what manner the *Chrysomelidæ* represent the *Predatores*, otherwise than in holding the second station in its own circle, does not appear; but the soft elytra of the *Clythridæ* seem to represent the *Malacodermes*. The resemblance, again, of such genera as *Erotylus* and *Stenochia* to *Blaps* and many of the *Silphidæ*, is so close, that it is difficult to distinguish one from the other; while the larva of *Hispa* is stated to be so like that of the capricorns, that we cannot be very far wrong in assimilating them: nevertheless, until the true station of *Sagra* and *Donacia* have been worked out, we look upon the station here assigned to *Hispa* as more than doubtful. However this may eventually be decided, it is quite clear that *Hispa* is a representation of *Lycus*,—with which, but for its obvious affinity, as we think, to *Alurnus*, we should have placed it. *Haltica* appears a subordinate division, or sub-family, among the *Chrysomelidæ*; but that which is held by the *Cleri* of Latreille must also be left for future investigation.* A rapid survey of the chief groups, which probably enter into each of these families, will now be given.

(278.) This is doubtlessly the least elegantly diversified, in the forms of its contents, of any of the divisions of the *Coleoptera*: a great number of genera yet uncharacterised exist in it; and it also contains many very abundant in the species. A more than adequate compensation, however, for this uniformity and inelegance of shape, is made by the remarkable brilliancy of the insects incorporated in this group, which contains some, perhaps, more dazzling than any in the whole circle of beetles. In confirmation of this assertion, we need but mention the single genus *Lamprosoma*,—some of the species of which sparkle more vividly than even the most lustrous gems, and are equally fitted, as they have also been used, for personal decoration. We will first treat conjunctively the *Cassididæ* and *Hispidæ*, the first and last members of our circle, and, consequently, where it is confluent. The structural differences between the two families are but slight, and consist chiefly in the form of the thorax and the developement of the head, which, in the *Cassididæ*, is concealed by the enlargement of the anterior portion of the thorax; whereas, in the *Hispidæ*, it is entirely exposed. The South American genus *Imatidium* appears to connect the two forms, in which the head is less exposed than in *Hispa*, and the thorax less developed than in *Cassida*. The insects of the latter group are usually of small size, and the typical genus itself is of universal distribution: they are much more brilliant in their colours when alive than dead, which then fade; although they may be renovated for a short time by immersion in boiling water. Some have the disk of the elytra elongated perpendicularly into a tall spine, presenting a convenient hold for removing them from plants; others have it elevated pyramidically: they present a good deal of difference in the outline of their form; some being quadrate, but the most regular and usual figure is a perfect oval. Their larvæ possess the singular habit of covering themselves with their excrement, which is held suspended over the body by means of a furcated process originating from the apex of the abdomen; and this crust they have the power of raising or depressing to suit their convenience. They feed upon the leaves of plants, upon the surface of which they take their transformations. The *Coccinellidæ*, which we have above associated with them, have, as we have there also shown, totally different habits, — being carnivorous. The perfect insects are very convex, frequently completely hemispherical: their tarsi have but three distinct joints; and their antennæ are short and gradually clavated, — the articulations of the club being transverse. They are very numerous, and occur in all countries; and are sometimes so prolific in individuals, that upon our coasts we have, in some years, seen the cliffs and shores densely covered with them. Such apparitions are welcome to hop growers, who may then expect redundant harvests, as the *Coccinella*, or ladybird, feeds voraciously upon his chief enemy, the *Aphis*. *Chilocorus* and *Scymnus*, in the same sub-family, have the same habits. In this group we must also associate the *Endomychi*, the majority of which feed upon funguses. These insects are ovate, convex, with the thorax usually much narrower than the abdomen, and either quadrate or trapeziform. Our solitary British species of the genus is of bright pale vermilion, studded with black spots; and occurs, sometimes, beneath the bark of trees, in considerable profusion. The exotic *Eumorphus* has the sides of the elytra, in some species, dilated like *Cassida*, and extending considerably beyond the abdomen: their antennæ are dilated into an abrupt, compressed, three-jointed clava; and in some the inside of the anterior tibia of the male has, towards its apex, a long decumbent spine. Other cognate genera have not the sides of the elytra enlarged.

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* Mr. MacLeay conjectures they belong to the same tribe as *Meloë* and *Mordella*,—that is, to the *Malacodermes*; a supposition which seems to me highly probable.

(279.) Our next sub-family, the *Chrysomelidæ*, are convex insects, generally ovate: they differ from our second section of the preceding, in having four obvious joints to the tarsi; antennæ not clavate; and their larvæ, at least those of the type, are naked, and feed upon the leaves of plants, leaving nothing but the fibrous skeleton. The *Galerucidæ*, which contain also *Haltica*,—but we think very incorrectly, considering the different structure and habits both of larva and imago,—are a component portion of the present family: the latter are remarkable for the great enlargement of their posterior legs, which gives them the power of leaping; and they are the only insects, throughout the phytophagous division of the *Coleoptera*, that possess this power. Their larvæ and themselves are exceedingly destructive to plants; and our farmers have frequent occasion to execrate their existence, on account of their spoliation of turnip crops,—one of these little skipping insects being the well-known and formidable turnip fly; their larvæ feed between the membrane of leaves, upon the parenchyma. *Tritoma* and *Triplax*, which British entomologists have usually associated with the *Engidæ*, evidently come into this group somewhere adjacent to *Chrysomela*: they are fungivorous insects; and some of the exotic species are very conspicuous for size. The types of the sub-family *Galeruca* are formed like the preceding, but they do not jump, and occur chiefly in humid situations.

(280.) Our next family, the *Clythridæ*, are all insects of a heavy obtuse form; sometimes, as in *Chlamys*, of a rough and very unequal surface, more resembling a cluster of irregular crystals than an insect: it is exclusively American. *Clythra* itself is more elongate, nearly cylindrical, and very obtuse at both extremities; it has short serrated antennæ. *Cryptocephalus* is of a somewhat similar form; but its antennæ are usually very long, especially in the males, and slightly clavate at the apex. Its head, also, is retractile within the thorax, whence its name; whereas in *Clythra* it is deflexed, and has very prominent mandibles. The latter appears confined to the Old World; whereas *Cryptocephalus*, which is a very numerous genus, nearly 200 species being known, has a universal range. The larvæ of the insects of this family have a peculiar appearance, very unlike the neighbouring families, and more like those of the *Lamellicornes*,—being considerably swollen at the posterior extremity, and frequently curved. Like the *Cassidæ*, these insects use their excrement as a protection,—forming a case of it, into which they retire, protruding only their heads and legs. Many other genera—as the beautiful *Colaspis*, *Eumolpus*, and *Lamprosoma*—belong to this group; the latter exclusively American, and of considerable refulgence, as we have before observed, and whence Mr. Kirby named it generically.

(281.) The *Erotylidæ* are our next family, and have, like the *Eumorphi*, an enlarged compressed club to the antennæ; the body very gibbous, the gibbosity almost angulated; and they have also longer legs than the cognate families: they are fungivorous insects. It is exceedingly remarkable, that several truly heteromerous genera find their complete analogies within this circular group of insects; for we cannot consider them close affinities, although the resemblance is frequently so great, that any but a skilled entomologist would, from their appearance, place them with the genera they resemble. This shows how important it is to divest ourselves of the influence of appearance, and to examine carefully; for it is particulars only that can confirm identity. As instances of these deceptive forms, I need mention but a few; namely, *Spheniscus*, *Nilio*, *Cossyphus*, and *Helæus*. Although the structure of parts would justify our placing *Languria* in this sub-family, yet its general form is so dissimilar,—it being very elongate and linear,—that we consider systematists ought to find a more appropriate place for it. We cannot think that, like *Tritoma* and *Triplax*, it is fungivorous.

(282.) The *Hispidæ* are our fifth family, and, from their close affinity to the *Cassidæ*, thus complete, as we have before observed, the circle. They are depressed insects, with short legs, and porrect moniliform antennæ. The typical genus is usually surrounded by spines, which give it a formidable appearance, as well as a name. Although the structure of the perfect insect associates it very closely with our first family, yet the form and habits of its larva as widely separate them; for the larva of the present feeds, like that of *Haltica*, between the membranes of leaves, upon their parenchyma. This larva is robust and of a tapering form, and undergoes all its transformations within the leaves; different species frequenting different plants. The largest insect of the group is contained in this family, in the Brazilian genus *Alurnus*, which seems to replace there the *Hispa* of the Old World; and yet this insect is only comparatively large; and the character of the whole group is to contain insects of small dimensions.

(283.) There being no greater difference between *Hispa* and *Cassida* than we find between *Haltica* and *Galeruca*, we may still hesitate whether we might not introduce *Sagra*, and its affinities, into the place of the *Hispidæ*, and transpose these into the circle of the *Cassidæ*; but, whether this be their confirmed position or not, we cannot have a better opportunity to notice the few conspicuous genera that would otherwise want a locality. *Sagra* is eminently distinguished for the enormous size of its posterior femora, and its long curved posterior tibiæ,—thus greatly resembling the structure of *Leucospis* and *Chalcis* among the *Hymenoptera*; for as, in them, this structure is unaccompanied with the power of leaping, a similar incapacity and structure we observe also in *Bruchus*. The *Sagræ* are beautifully coloured insects, of a green, blue, or a rich purple vinous tint. We find this family containing other genera of a similar form,—as *Megamerus*, a rare New Holland genus; and *Megalopus*, from South America; and we know other African forms yet undescribed. A closely allied genus, *Donacia*, is, perhaps, one of the most beautiful of the *Coleoptera*; they are metallic, and of every variety of tint: their larvæ feed within sub-aquatic plants; and it is upon these that the perfect insect is found, for a short time, about midsummer: these may be termed, also, sub-aquatic, for they have the power of walking down water plants considerably beneath the surface—it is presumed, to deposit their eggs; and to enable them to retain their hold, we find them furnished with very powerful claws, by which they tenaciously adhere. This is a structure evidently appropriated to this purpose; for we find it again, but with increased developement, in *Macroplea*, which has similar habits, and belongs to the same family; and in *Macronychus*, which has the habit of clinging to floating wood in strong currents, and belongs to a group closely allied to *Parnus* and *Dryops*. The genus *Lema*, or *Crioceris*, will terminate our notice of the monilicorn *Coleoptera*. These insects seem a connecting link between *Galeruca* and the *Sagridæ*; like the former, they are frequently very destructive: the little black larva of one species especially, the *C. Asparagi*, destroying the crops of asparagus, and the *C. Merdigera* being equally obnoxious to the white lily; here, however, less detrimental to the results of men's industry and expectations, than in the preceding case. They are elegant and gaily coloured insects. [(278—283.) W. E. Sh.]

CHAP. X.

COLEOPTERA, *continued.*

ON THE MALACODERMES.

(284.) THE MALACODERMES, or winged tribe of beetles, is composed of those genera, where the elytra are either remarkably soft, or much abbreviated: of these, the genera following, mostly representing sub-families, seem to be the chiefly typical: —*Lampyris, Meloë, Cantharis, Lytta, Lycus, Dictyoptera*, &c. We adopt the expressive name given to the majority of these insects by Latreille; but we by no means include all he has arranged among his *Malacodermes*, and we incorporate others, as is apparent even in the foregoing list, which he has placed in widely different situations. Mr. MacLeay seems to be the only naturalist who has had any clear conception of this group,—one of the most natural in the whole order, to a philosophic mind, but altogether incomprehensible to a mere methodist, who is guided by methods built on the form of the palpi or the joints of the tarsi. True it is, that soft-bodied insects, with imperfectly formed elytra, are scattered in many other tribes,—as the *Staphylinidæ* among the *Predatores*, several forms belonging to *Prionidæ*, and many others in the *Lepturidæ*, as *Necydalis*, &c.; but as, in other parts of their structure, they retain all the characters of the groups to which they severally belong, there is no danger of their being mistaken or confounded with the true *Malacodermes*,—they are merely representatives, not congeners. In the slight sketch we are now employed upon, any attempt to define a group so varied, by precise characters applicable to the whole, would be altogether premature, even were it practicable. It is sufficient to state, therefore, that not merely the elytra, but the whole body and limbs, of these beetles are soft; that nearly all are very much depressed; that the elytra do not embrace the body, as in ordinary beetles; and that the head is never sunk in the thorax. Whether any subordinate characters may be furnished by the larvæ, it is impossible to say. It seems, however, that in more than one instance, among the typical forms, these are furnished with caudal appendages,—a circumstance which tends, in this instance also, to corroborate MacLeay's impression of this being the thysanuriform type of the *Coleoptera;* in which case it would be perfectly analogous to *Podura* by its larva, to *Staphylinus* by the perfect insect, and to all others related by analogy to these groups.

(285.) As we are now proceeding by synthesis, we shall make no attempt to throw these insects into a circular series,—a process which might rather tend to retard the investigation they require, than to strengthen our present theory. Nevertheless, as some mode of arrangement becomes absolutely necessary, we shall intimate what appear to us — for reasons subsequently stated — the primary types or families of the whole. These may be represented by the following five genera: — 1. *Lampyris;* 2. *Meloë;* 3. *Lymexilon;* 4. *Mordella;* and, 5. *Lycus.*

(286.) The *Lampyridæ*, or glowworms, if not the most typical, are certainly the sub-typical family, of the whole order. Its most predominating character is to have the thorax dilated into a shield, the margins of which project on every side, and very often entirely conceal the head; the legs are short, with all the joints unusually compressed, the tarsi of nearly equal thickness throughout, and the apparent joints only four. The antennæ are variable in the different genera: in some, they are remarkably pectinated; in others serrated; many are merely compressed; while, in the aberrant divisions, they are almost filiform. The body is always long, generally narrow, and remarkably soft. The genus *Amydetes*, where the antennæ are remarkably developed, and the head completely hidden under the dilated margin of the thorax, is probably the most typical form: it contains, no doubt, its own sub-genera; but the variations of the antennæ are so numerous, differing in almost every species, that no reliance must be placed upon these modifications, for sub-generic characters.* It is generally imagined, that the great majority of the typical *Lampyridæ*, like those of the South of Europe, are luminous: this supposition, however, is against our personal experience. We have seen, on a summer's night, in the suburbs of Genoa, the air perfectly illuminated with millions of one of these species; but this we never witnessed in Brazil. We do not remember, indeed, to have remarked the luminosity of any one of the numerous *Lampyridæ* found in that country, during any part of our travels in Tropical America. Several other forms, more or less related to these insects, enter within the family: those, for instance, having the exserted head of Latreille's *Pyrochroides*,—as our *Pyrochroa rubens*, where the thorax is still nearly orbicular, but reduced to the ordinary dimensions,—serves to indicate the passage between this family and the *Cantharidæ*; while the approach, on the other side, to *Lycus*, is still more evident. Latreille, indeed, includes the latter insects as a part of the *Lampyridæ*; and the analogies of both may, possibly, show he is quite correct in this,—particularly as we should then have but little scruple in raising his *Cleri* to the rank of one of the aberrant families: but at present we are chiefly guided by synthesis; and when we see so strong a resemblance between many of the Brazilian species of *Lycus* and of *Hispa*, we cannot but suspect that these two groups, standing at the confines of their respective circles, connect the *Monilicornes* with the *Malacodermes*,—in other words, that this is a relation of affinity, rather than of analogy.

(287.) The next typical family, or the *Cantharidæ*, may be represented either by *Lytta* Fab., or *Meloë*. These insects differ most materially from the former; the thorax, instead of being large, dilated, and flattened, is small, very narrow, and convex; while the head is broader than the thorax, large, cordiform, and bent considerably downwards; it is so much exserted, or detached from the thorax, that the neck is seen externally: the tarsi are unlike all other insects out of this tribe; they are rather compressed than depressed, and are so nearly of the same thickness, that their slightly cuneated shape is not at first perceived;—such, at least, is the case with *Meloë*, *Mylabris*, and certain forms more allied to the typical *Cantharidæ*; but in others, these parts are considerably modified: in *Lytta*, for instance, they are much more lengthened, often very slender, and the claws on the joint appear as if double. The great enlargement of the head, in comparison to the thorax, appears to us the most prevalent character running through this family, and is more especially developed in *Horia*.

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* See figures 4, 5, and 6. on plate 39 of Griffith's Cuvier, vol. xiv.

(288.) We have seen that, in *Meloë*, the elytra are more abbreviated than in any other group yet noticed; but in some of the *Lymexylonidæ*, these organs are generally reduced so much as merely to resemble a small scale, almost precisely like those of many of the *Staphylinidæ*. Like them, also, they have the thorax square, and the body greatly depressed,—particularly seen in the individuals of the genus *Atractocerus*. Many of these singular forms so much resemble the *Cantharidæ*, that Linnæus included them in that and the genus *Meloë*. Upon these grounds, we consider the *Lymexylonidæ* as forming a distinct family, which, by means of the *Pselaphi* and the *Staphylinidæ*, connect the two extremes of the entire order of *Coleoptera*, and unite the five tribes into one great circle.

(289.) The two remaining groups, which appear to form aberrant families in this tribe, are represented by the genera *Mordella*, and either *Lycus* or *Clerus*: the former appears to us to be almost certain; but, as we have before observed, some difficulty arises in deciding which of the two latter should stand in this situation. The short obtuse head of the *Mordellidæ*, of equal breadth, and almost sunk in the fore part of the thorax, is without parallel in this tribe, and immediately reminds us of the *Elateridæ* and other analogous forms,—a resemblance rendered doubly evident by the enlargement of the thorax. If the *Cleri* do not form a subordinate group in the family of the *Cantharidæ*, then it will take the place, in all probability, of *Lycus*, and thus present a direct analogy to its prototype *Bostrichus*, in the capricorn circle. If, on the other hand, *Lycus* intervenes between *Mordella* and *Lampyrus*, there are not wanting species of the former, which, in their pectinated and nearly serrated antennæ, the rugosity of their elytra, and the form of their thorax, render such a passage in some degree probable. It is obvious, however, that, in the rapid manner we are now proceeding (imposed upon us from the vastness of the subject), all such minor difficulties must be left for analysis. If, in constructing the tribe before us, we have brought together the elements of a natural group, and thereby placed, under one head, a multitude of insects now scattered over the whole of the *Coleoptera*, our chief object will be gained. The next step will be to analyse these groups, and appropriate to each its respective genera and sub-genera. This task must be undertaken by those who confine their attention to small divisions, without embracing, as we have done, the whole animal kingdom. Although we shall not attempt, under these circumstances, to construct a regular table of analogies for this tribe, there are, nevertheless, some resemblances which are too striking to be passed over. Setting aside the obvious similarity between *Hispa* and *Lycus*, which we deem, for the present, an affinity, it is not a little singular how strongly the *Cassidæ* are represented by the *Lampyridæ*: in both, the elytra project considerably over the sides of the body, without embracing it; and in both, the margins of the thorax are dilated so much as to hide the head either partially or entirely. Thus we find the two typical families, at least, have their direct analogies in the neighbouring circle of the *Monilicornes;* and this fact, although insufficient to compensate for the absence of the other analogies, tends to show that, in the typical groups, at least, we cannot greatly err.

(290.) The habits of the insects are of a mixed character: many are exclusively carnivorous,—for instance, those which are parasitical; others are only carnivorous in their larva state; whereas, in others, in this state, they are herbivorous, and their taste for flesh is acquired only on assuming their perfect condition. We find in this group, likewise, structural peculiarities of a very marked character, for we have here both heteromerous and pentamerous insects. We have already mentioned some of the chief distinctions of our first family, the *Lampyridæ*, for instance,—namely, their phosphorescent luminosity, which we are assured is the beacon of love, the females being frequently apterous; and as a seeming corroboration of this, it is the female which is the most brilliant. They appear to possess a control over its exhibition, and which is evidently a wise provision; for this "beaming lamp" would attract their enemies as well as their friends; and what was intended for their preservation and continuance, would otherwise be the guide to their destruction. It is the under side of the terminal segments of the abdomen which display this brilliancy; and although we have stated above, that we never observed this phosphorescence in the Brazils, we do not mean to say that it is improbable, for the Brazilian species equally possess the analogous pale spots and segments, whence the light issues in those European species we are acquainted with. This family is very numerous, and contains many very natural genera: the most remarkable are those with greatly developed antennæ, as *Amydetes*, in which they consist of at least twenty joints, each of which throws off a long curving plume; *Phengodes*, also, where, however, the antennæ retain the normal number of eleven joints, are not outvied in their beauty by the last, — for here each joint emits a double convoluted feather. In *Lamprocera*, which also throws out from each joint a double branch, these are porrect and divergent; but in others, the antennæ are simple. In the typical *Lampyris*, the females are apterous; and in the proximate *Phosphænes* the elytra are abbreviated: in *Luciola*, they are entire; and the species of the latter are sometimes so prolific, that on a summer's night they completely fill the air, and sparkle about in their erratic vagaries, presenting an agreeable spectacle, and one which the *Luciola Italica* constantly exhibits to our absentee countrymen. Species of the three last are those which chiefly occur in Europe; the type, only, ranging as far north as our island. Tropical countries, and especially South America, seems to exuberate in them; thus compensating in an additional instance, in those regions, by the prolific energy of physical phenomena and powers, for the debasement and enervation of intellectual and moral characteristics. Like the neighbouring genus *Drilus*, *Lampyris* feeds upon snails; and the former genus is remarkable for its fleshy larva-form female, which, we believe, wholly lives within the shells of snails.

(291) Passing to the next family, we appear to enter it by its pentamerous division, or those insects which have the greatest affinity to the preceding. We thus proceed by means of *Telephorus*, — a genus of universal distribution: *Malthinus* is distinguished for its abbreviated elytra and prominent eyes; and in the next sub-family, the *Melyrinæ*, we observe *Malachius*, which has the power of projecting from various parts of its thorax, under excitement and irritation, large fleshy vesicular appendages, the uses of which are not correctly known. By means of the next sub-family, the *Dasytes*, we have an intimation of the proximity of the *Cleri* to this circle, if not constituting a family of it: a very easy transition is effected from the *Telephorinæ* to the typical heteromerous *Cantharidæ*; for in general habit

the insects are remarkably similar, especially to an inexperienced eye. It is from this sub-family that we obtain the officinal *Cantharides*, so extensively used as a vesicatory. Insects here, again, put forth a claim to our consideration and notice, and are not such trivial objects, or so despicable, as it pleases many to consider them. For, thus having with the silkworm clothed us, and this clothing then gaily coloured and decorated by the cochineal insect (*Coccus Cacti*), the bee lights up our houses with its wax, and with its honey it furnishes our tables with a luscious luxury; and when the intemperate enjoyment of this produces repletion and inflammation, another insect is offered us, in the blister beetle, to cool our fever, and to restore us to health. Nor are the uses of insects confined to these few; and perhaps the indirect benefits we derive from them are more substantial than those which are more obvious; yet these necessarily involve the reflection of how many thousands of our fellow creatures are daily occupied in, and derive their whole means of living from, the cultivation and produce, and the manufacture of the produce, of these creatures. If we view their study, even merely with the eyes of the political economist, all this must strike us; and besides, who can say that an insect may not be discovered, which shall surpass all yet known in conferring benefit on the human race: and surely, when we reflect on the devastation and injury caused by others, the study ought to be promoted upon the principle of self-defence. With all these, and the additional and superior object to be obtained from their study, by its opening to us a large chapter of the wisdom and goodness of God in the creation, pray let us hear no more of entomology being talked of as an idle and frivolous pursuit. To return from this digression: the insect called "the Spanish fly," is a beetle of a richly brilliant green colour; it is found throughout Europe; and within the last few years, it has occurred in great abundance in various parts of the South of England. Whether our native species would be as efficient for medicinal purposes, as those coming from a hotter climate, we are unprepared, in the absence of the requisite experiments, to say; but it is certainly to be regretted that such have not been made; and that, in lieu of it, paupers were employed in Suffolk and Essex to collect them and to burn them. In the East, various species of *Mylabris* and *Lytta* seem equally well known to possess, and are used for similar purposes. We may here, again, further remark, that almost the whole of this family is excessively prolific in the produce of individuals; for, of the majority, in their proper season, their peculiar habitats literally swarm with them. In this sub-family we observe very many striking structural peculiarities, notwithstanding a tolerably general uniformity of appearance, excepting only in a few instances. Thus, in this type, we have moniliform antennæ; in *Hycleus*, *Mylabris*, &c., these organs are considerably enlarged at their apex, differing generally in the number of their joints. *Œnas* has them fusiform; and in *Lytta* they are attenuated towards their apex. They are all more or less peculiar for the structure of the claws of their tarsi: thus, in *Lydus* these are strongly serrated beneath, and in *Tetraonyx* they are bifid, as well also in other genera, and particularly so in *Meloë*, which presents, perhaps, the greatest divergence from typical characters, if we except only some apterous females, of any insects throughout the *Coleoptera*. They are soft, swollen insects, apterous, but having abbreviated elytra, which are rounded at their extremity, and lap over each other. They possess the property of exuding, when captured, a yellow, oleaginous liquid, which stains the fingers, and has a somewhat fœtid or faint smell; not unlike that ejected by *Coccinella;* whereas that of *Timarcha*, among the *Chrysomelidæ*, is of a sanguineous hue, and more watery and profuse. Much obscurity still envelopes the natural history of the *Meloë*: it has been assumed that those little *Pediculi*, found so frequently upon many species of bees, especially *Andrenæ*, whence Mr. Kirby gave them a specific name, is the larva of this insect; and that it resorts to the bees for the purpose of being conveyed into their nests, to feed there upon the provision collected for the larva bee. Some degree of plausibility is given to these statements, from the circumstance of very similarly constructed and equally active creatures being bred from the yellow masses of eggs deposited in excavated holes by the *Meloë;* and thus these statements have received the sanction, and grown into the belief, of many eminent entomologists. Having thus had the seal of authority stamped upon them by such men as De Geer, Latreille, St. Fargeau, and Erichson, it might be considered rash to question their accuracy; for this opinion would, of course, be the result of careful and rigorous inquiry. There is, however, drawn out opposite this formidable array, a phalanx of great men, whose patient accuracy of investigation is not to be impugned, or their judgment questioned; for here we have Swammerdam, Kirby, Walckenaer, and Léon Dufour, who all treat it as an error; and the strongest probability of correctness consorts itself with them. The first circumstance that strikes us in the inquiry, is, the apparently infirm footing that the science stands upon; for here we have a dispute between men competent in every respect for the investigation, whether a certain creature is a perfect insect,—for if it be a *Pediculus* it must be so, — or the larva of another in its first stage of developement! Upon the very threshold, we have the strongest presumptive evidence that it cannot be the latter; for success has never accompanied even the greatest care to breed these supposed larvæ, although many individuals have tried; and they have still remained the same little active, hexapod, double-tailed creatures they originally were,—neither increasing in size, nor altering in shape,— and have thus continued until they have at last dispersed or died. The arguers *pro* have attributed this to their not having proper food, or some particular in their mysterious economy, insoluble even to the most anxious wish to elucidate the whole difficulty of the question;

and, of course, the arguers *con* have availed themselves of it to strengthen their views. It must not, however, be inferred, that the point has been canvassed for the sake of disputing only, for this would be beneath the great men whose names occur in the discussion; but it is the circumstance of a fact being withheld from our knowledge, and continuing involved in its original obscurity, even after the researches of two centuries, that gives a permanent interest to it. Curiosity has for a characteristic an inveterate dislike to be thwarted in its pursuit, and satisfaction; and an incentive stimulus is here given to it, by the assumed peculiarity of the case contradicting what we know of all analogical developement. Our view is, that there is a strong resemblance between the two creatures, but that they are not identical; and the probability of this is somewhat strengthened, by the larva of the neighbouring *Cantharis* being also much like these hexapods. A further corroboration of our view is derived from a statement made by Frisch, which appears to have been altogether overlooked in the discussion: whether this has proceeded from later entomologists feeling satisfied with the luminous statement made by Latreille, of all that he knew of the history, derived chiefly from De Geer, he not knowing German, and the description of De Geer; or whether the subsequent inquirers have been unconversant with the German language, and therefore could not test De Geer's accuracy, in whom the important omission must have been accidental,—we know not; but the fact is, that Frisch, who wrote before 1730,—for it is in his 6th Treatise, and we have an edition of the 7th, dated 1728,—explicitly says, "After *numerous successive changes of skin,* in the last of which they acquire their wing-shaped cases, they remain during the winter in the clayey earth, where no humidity can reach them, until the following year, about the month of May." Here is a positive statement made by an accurate observer, clearly from the observation of facts, and certainly without bias, as his remarks were made more than thirty years before the subject was first mooted. It is to be regretted that Frisch is not more ample in his particulars; for we are still left uncertain at what stage of the developement, or at what change of the skin, these very active creatures are transformed into the heavy, dull larvæ they become when they have acquired their full size, — in which state they are well known. The change, we conceive, must be made early, or these larvæ must early bury themselves, and thus avoid detection; otherwise their increased size and activity would not so entirely have escaped all accidental discovery as they seem to have done. We have given more space to this subject, from its being one of the most interesting inquiries connected with entomology, than our limits would otherwise have justified; for, in point of interest, it is certainly not exceeded by the obscurity that hangs over the natural history of the *Stylops*, — in connection with which we may here mention incidentally, although it bears upon the point we have been alluding to, that these *Stylops** have been observed to have a hexapod parasite, which were detected creeping out of the head of its larva, protruding through the segments of an *Andrena*. May not this be the larva of the *Pediculus?* which is thus necessarily found upon bees, and occasionally upon bee-like flies, *Eristalis*, *Syrphus*, &c.; their instinct being deluded by the resemblance, when these *Diptera* have alighted upon flowers, where these *Pediculi* have found themselves, having strayed from the bee when it visited the blossom. We throw this out as a suggestion.

(292.) To pass on from this interesting subject, we observe some curious particulars of structure in this family, in the greatly enlarged head of *Horia*, a species of which, according to Lansdown Guilding, is parasitical upon the bee *Xylocopa teredo;* and another species is distinguished by its enormously developed mandibles. The closely allied *Cissites* has largely incrassated posterior femora, — a structure observable in other genera of this family group, as we see in *Oncomera*, *Nothus*, and *Œdemera*: these are, however, as is usually the case with anomalous structural features, a characteristic of the male insect only; an observation still further exemplified in the most extraordinary antennæ of the male *Cerocomæ*, the description of which would scarcely convey a distinct idea of the confusion of so heteroclite an organ. The same sex of the same insect has an equally remarkable developement of the maxillary palpi; but some of the most striking instances of curious palpigerous structure, we shall find in the next family. In *Nemognathus* and *Gnathium*, cognate genera, we find the maxillæ elongated into two slender filaments, half as long as the body. This circle seems to present several connecting points with other groups; thus, we have at once an instance of it, by means of *Notoxus*, — which, by the way, is remarkable for its produced thorax suspended over the head, — through *Scydmænus* and the *Pselaphidæ*, to the *Predatores*. We have also, from the vicinity of this point, in the attenuated elytra of *Sitaris*, — a genus parasitical upon *Osmia*, one of the mason bees, — an intimate link of connection with the fourth family of this circle, the *Mordellidæ*; but it is evidently through *Pyrochroa* that we approach our next family: —

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* Westwood, Trans. Ent. Soc. ii. 186.

(293.) The *Lymexylonidæ*, the name of which expresses at once their economy and habits, for in their larva state they are excessively destructive to timber. Indeed, one of them, the *Lymexylon navale*, was found so injurious to the ship timber in store in the dockyards of Sweden, that Linnæus was consulted upon the best mode of checking the ravage; and upon ascertaining the true cause, he suggested a very effective one, — by the immersion of the timber under water during the breeding period of the insect. The most striking feature in this small group of insects, all of which are pentamerous, (consisting, as yet, of only three genera; for we doubt if *Cupes* and *Rhyssodes* belong naturally here,) is the remarkable maxillary palpi in their males:

these organs, in *Hylecœtus*, are strongly pectinated, like a hand with many fingers,—the joint representing the thumb setting off in opposition to the others: in *Lymexylon*, they consist of several ramose branches, springing out of a large basal cup-like joint: in *Atractocerus*, they are more regularly pectinated; and this last has its eyes nearly meeting on the face, and very minute elytra, the body excessively long, the wings themselves expansive, and folding in repose merely longitudinally, and, of course, wholly exposed. We surmise, from the structure, that it must be a most active insect, although nothing is known of its natural history, it being exclusively intertropical, where it is, doubtlessly, the representative of the two other typically northern forms, and exercises there similar functions, which are certainly to accelerate the decomposition of dead trees, by perforating them in all directions. This agency we have had occasion to notice in the *Bostrichidæ* and elsewhere. Nature thus operates by various means to accomplish one end,—to clear away that which has become dead, which we cannot, however, here say has *run* its course, but has consequently become useless,—to make room for that which has to live; and to produce this result the more rapidly, for otherwise dead vegetation would stifle the living, and choke its growth, she introduces these little agents; thus every where exhibiting her prolific energy of vitality, by making all her purposes subservient to the extension of life and living beings in every possible form and organisation; for so varied are her plans and purposes, and her means of accomplishing them so interminable, that the imagination cannot conceive a new form that has not been, or does not now exist, and its own combinations of old ones are so monstrous, that Nature's monsters are symmetrical in the comparison. The insect world, throughout, extensively exhibits these wonder-working phenomena, and displays conspicuously the gigantic effects of such seemingly insignificant and inefficient agencies.

(294.) Our next family, the *Mordellidæ*, is also of limited extent, although more numerous than the preceding. They are usually small gibbous or humped insects, their longitudinal section exhibiting the segment of a circle. They are frequently large and thick in front, and much attenuated behind; and in many, as in the genuine *Mordella*, that extremity terminating in an exserted ovipositor. They are all very active creatures, flying with great velocity and promptitude, and to facilitate this, in many genera, the elytra are attenuated and abbreviated, as in *Rhipiphorus*, *Emenadia*, *Myodites*, &c., — the former of which is parasitical in the nests of wasps, and all, in the males, have flabellated antennæ; and the last is so active in its motions, and its elytra are so abbreviated, that it has received its name in allusion to these circumstances. It is with these insects that Sundeval's extraordinary genus *Symbius*, which is parasitical upon the *Blattæ*, must be associated,—the females of which, like those of *Drilus*, are destitute of wings and elytra, or even their indication. The species of *Mordella* are gaily decorated with markings, usually white upon a black silky ground; *Orchesia* has the power of jumping; and *Pelecotoma* contains the largest in the family, which excessively rarely reach an inch in length; the majority are minute, varying from two to four lines. The most of them have spurs at the extremity of their long legs; and they are found almost exclusively upon flowers.

(295.) Our next family, *Lycus* and its affinities, if it should really form a distinct family, or, rather, a constituent of our first family, the *Lampyridæ*, consists, also, of but few insects. This circumstance strengthens our supposition that the requisite analysis will place the *Cleridæ* here, and remove these to where we have just suggested. They are very flat insects; and some, especially the African genus *Lycus*, have the elytra in the males enlarged, and circularly developed on each side. In *Catopteron*, these organs are not wider than the thorax at the base, but gradually enlarge towards the apex, where they are considerably wider than the body. The legs and the elytra are usually considerably compressed,—the latter dilated and serrated, and inserted closely together upon the face or forehead; but in the Nepaul *Tylocerus*, their basal and terminal joints are greatly enlarged. In *Dictyoptera*, the body is linear, as also in *Omalisus*; and in *Lycus* the thighs are considerably thickened, and the head prolonged in front into a porrected snout, with the palpi very conspicuously exposed. Many of these insects are sub-cortical feeders, and almost all are gaily coloured.

(296.) We have already hazarded the suggestion that the *Cleridæ* should occupy the present situation of the preceding family, and those be transposed into the circle of the *Lampyridæ*; in which case we should have another direct connection with the *Predatores* in this group. They have also a very close and intimate connection with *Dasytes*, in our second family. This is, perhaps, one of the prettiest families of the *Coleoptera*. They are tolerably uniform in figure, but present considerable differences in the structure of their antennæ, palpi, and tarsi: their most typical forms exhibit the former clavate—the clava being constructed of the three last joints,—the palpi securiform, and the tarsi pentamerous. But we have here, perhaps, the greatest succession of changes and differences of combination in these organs, of any extant, in so small a family, throughout the *Coleoptera*. They are very gaily diversified in their markings,—presenting us with rich blues, and purples, agreeable greens, vivid carmines, and pale vermilions, in all kinds of combinations and spots, with bars of white or yellow, and very generally considerable metallic brilliancy. In those which have distinctly five joints to the tarsi, *Priocera* has serrated antennæ, with the labial palpi securiform; *Cylidrus* has the seven terminal joints only serrated; *Axina* and *Tillus*, with the antennæ gradually enlarging to the apex, but the latter differing from the former, in all the palpi terminating in a securiform joint; and *Eurypus*, with a similar structure, has the four first joints of the tarsi with a long membranous appendage; and in *Tillus*, the sexes of one have been considered generally distinct species. In those which have but four distinct joints to the tarsi, there is a greater uniformity in the general structure of the antennæ, although *Enoplium* has its three terminal joints separated and serrated. Some of the species of *Clerus* are parasites in the nests of certain mason bees; and the genus *Thanasimus* occurs upon felled trees and timber, — its larva preying upon those of many of the wood-feeding genera, as *Apate*, *Bostrichus*, *Anobium*, &c. They are all very active insects; and some of the latter, in the distribution of their colours, and general form, have a remarkable resemblance to the hymenopterous *Mutillæ*, and whence they have derived their specific names. All these insects have the head rather wider than the thorax; the latter cylindrical, and constricted at its base, or swoln about the centre; although some, as *Corynetes* and *Necrobia*, have the sides of the latter slightly margined. These are found, usually, among heaps of bones, or upon dry carrion; and one of the latter is celebrated for being the cause of saving Latreille's life during the sanguinary period of the French revolution; in as far as the circumstance of its capture, in his prison cell, interested, through the medium of the surgeon that attended him, some influential scientific men, who stayed his debarkation to the colonies in a ship that was atrociously foredoomed to perish, with its cargo of transports, almost within sight of their native land. The largest species occur in the Mexican genus *Cymatodera*, and the universal *Opilus*. Europe is rich in species of the family; but New Holland appears to be their metropolis, if we may judge from the numbers, and the forms, we have seen recently imported thence. Very many genera are still uncharacterised in this interesting group. (290—296.) W. E. Sh.]

CHAP. XI.

ON THE NEUROPTERA.

(297.) On this, the last order of the *Ptilota*, our survey must be very brief, since our allotted space is drawing rapidly to a close. The general construction of the insects we arrange under this head, has been more than once adverted to, and their ranks among the other tribes of winged insects sufficiently demonstrated. The character of having four reticulated wings, assigned to the order by the great fathers of Science, and by which all its typical families are distinguished, is that to which we adhere; and which, in our estimation, is its leading distinction. Nothing definite can be drawn from its metamorphosis, which both Latreille and MacLeay are obliged to confess is "varied." With the exception of the *Phryganidæ*, which can scarcely be termed masticating insects, the whole of our neuropterous families are provided with jaws, and many, like the *Gryllidæ*, bite very hard. By our former diagrams, it will have been seen how perfectly this order coincides with all we have said of the AQUATIC TYPE of Nature, where the head is of unusual size, and the animal itself lives habitually in the water. Popular opinion, in this instance, has fortunately proved correct; for the dragon flies (*Libellulidæ*) are unquestionably the pre-eminent division of the order, and thus preserve their analogy to the fissirostral types in ornithology. Like the swallows and flycatchers, they seize their prey on the wing, and watch for it from a fixed station. In their larva and pupa state, they live entirely in the water; and even when they become winged, haunt the precincts of that element on all occasions: they have the largest heads of any insects in existence; and, like nearly all aquatic tribes, have great swiftness of motion. Next to these we place the *Gryllidæ*, or grasshoppers and locusts, whose heads are less developed; and whose upper wings, as typical of the *Hemiptera*, are thicker, and more inclined to become coriaceous than the under: the under wings, also, in both, are semitransparent, and are folded when at rest: they are all herbivorous, and thus again imitate the sub-typical division of the *Hemiptera*. Following these two families, we place the *Forficulidæ*, or earwigs, which thus enter in that part of the neuropterous circle which touches the *Coleoptera*. That this is their true station, may be proved by analysis; and is further confirmed by the opinions of several writers unacquainted with the theory we now maintain. "The *Forficulidæ*," as MacLeay truly observes, "are, in fact, coleopterous insects, with the metamorphosis and caudal appendages of true *Orthoptera*;" to which we may further add, they are the thysanuriform type of the whole of this circle. The insects forming the supposed order *Strepsiptera*, we place as the next, and the most aberrant family: they are representatives of the *Coleoptera*, and find their prototypes in several families of beetles, as well as in many of the parasitic genera in the hymenopterous and hemipterous circles. The affinities of these extraordinary insects, until the discovery of their most aberrant types, must ever remain a subject of doubt or dispute. Our own opinions have resulted from the utter impossibility of locating them elsewhere, the absence of any other distinct group sufficient to fill up this part of the neuropterous circle, and the opinion that some writers hold on their relation to the *Forficulidæ*. The whole question, as it now stands, is a matter of inductive reasoning, and of the synthetic principles of arrangement, and as such we leave it. On the fifth and last division, there can be no doubt. The *Phryganidæ* are partly neuropterous and partly lepidopterous insects; thus blending the characters of the two orders, and bringing them into juxtaposition. Our space will not permit us to state those reasons which make us decline to view these five groups as orders,—a rank to which many excellent entomologists have elevated them. The system of representation, of itself, totally forbids this: the contents of the class *Ptilota* must agree with those of the *Aptera*, and both must have their definite number of prototypes in the classes of the vertebrate animals.

(298.) The affinities by which the order is united into a circle of its own, may be thus briefly stated. The *Libellulidæ* comprise, beside the sub-family of that name, the *Mymeleoninæ*, the *Panorpinæ*, the *Terminæ*, and the genus *Mantispa*; which latter appears to be only a representation of the *Mantinæ*. We leave these families for the *Gryllidæ*; of which the genera *Mantis*, *Gryllus*, *Locusta*, *Acridium*, and *Blatta*, form the types of the sub-families, and represent those in the *Libellulidæ*. The crickets seem to open a passage to the *Forficulidæ*, which, with the *Stylopidæ*, contain so few genera, that we shall not venture to designate their rank. Finally come the *Phryganidæ*, the leading divisions or sub-families of which are the genera *Ephemera*, *Phryganea*, *Hemerobius*, *Perla*, and *Psocus*. Each of these correspond analogically, and in precisely the same order, with the primary types, already enumerated, of the *Libellulidæ* and the *Gryllidæ*. We look upon these latter as the typical and sub-typical groups; and the other three as aberrant. A brief notice on the principal genera, in each of these, is all that our limited space will now admit of.

(299.) The large group of insects, here treated collectively as *Neuroptera*, present considerable differences in their structure, transformations, and economy; indeed, so much so, that modern systematists have concurred in treating several of the subdivisions, of which they are here constituted, as distinct orders. Without reference to these views, we shall give some few particulars of their natural history in the order of succession above laid down; and, in consequence of the difficulty of finding general characters to combine the successive groups, we shall treat the sub-families independently of each other.

(300.) The insects constituting the *Libellulinæ* are well known to all persons who know any thing of the country, as dragon flies. They are essentially flying insects; and the four powerful organs whereby they accomplish this faculty, consist of usually a pellucid glassy membrane, which is closely and thickly covered with a reticulation of nervules; whence, κατ' ἐξοχὴν, as the most typical members, they give a name to the entire group called from them *Neuroptera*. In velocity of flight, and the power of its protracted continuance, they doubtlessly exceed all other insects; and Leeuwenhoek records an instance of a swallow being unable to overtake one, which it continued in pursuit of for some time. They have been divided into two groups, of which *Libellula* and *Agrion* form the respective types, — a subdivision supported, in some degree, by differences in the structure of their larvæ. The characters, upon which it is founded in the perfect insect, are, that in the former the head is globose, and, in repose, the wings have a horizontal distended position; whereas, in *Agrion*, they are united vertically over the body, like the butterflies, and their head is transverse. Several exotic species of the latter genus are remarkable for the length and slenderness of their bodies: thus, the *Agrion Lucretia* from the Brazils is 5½ inches long, and its body scarcely more than the eighth of an inch thick. These gay insects may be observed sporting in every variety of evolution over ponds and brooks, to which they give considerable animation; and it is here that their entirely aquatic larvæ pass their lives. These, which undergo an incomplete metamorphosis, progressively acquire the rudiments of wings; and when they have attained their full growth, they creep up the stem of some water plant, and fixing firmly by their legs, the skin splits down the back, and the perfect insect creeps out. A very short time suffices to expand its wings, and it then sweeps forth a denizen of the air. In this state it is remarkable for its very powerful mandibles,—organs which it possessed of fearful capacity in its preliminary stages, but which then had the adjunctive assistance of a singular apparatus, which, in repose, covers the lower portion of the face like a mask; but which, possessing a lengthy joint, the insect has the power of projecting forwards; and it thus forms a prehensile organ, by means of its lateral articulated hooks, whereby the creature seizes its prey, and conveys it to the mouth; and this is doubtless to compensate for its imperfect means of progression through the water. The eyes of the larger genera of the perfect insects—for instance, of *Æshna* and *Libellula*—occupy nearly the whole of the head; whilst *Calepteryx* and *Lestes* are distinguished for the brilliant metallic colours of their wings and bodies. They are all natives of all parts of the world, throughout which they are tolerably equally distributed.

(301.) The MYRMECOLEONTINÆ differ considerably from the preceding insects; thus although they have equally prominent eyes, they have never ocelli; their mandibles are comparatively small; they have lengthy palpi,—organs wholly deficient in the preceding; and their antennæ, instead of being subulated, as in those insects, are here, although short, considerably clavated, and the club is compressed and curved. These characters are sufficient to distinguish them from the preceding, did not their larvæ totally disunite them. Their economy, in this stage of their existence, is exceedingly interesting. This larva, even more unlike the former, than is the perfect insect, inhabits dry sandy situations: here it forms a funnel-shaped hollow, the superior edges of which, when the larva is approximate to its full growth, are about a foot in diameter; and the sides are formed of such loose sand, that any insect approaching the edge, inevitably slides down; where, at the inverted conical bottom, this creature lies with merely its large mandibles protruding, ready to seize the unfortunate creature that comes within its grasp, which is sucked completely dry. Having thus exhausted its juices, the husk is placed upon its head and legs, and a sudden jerk casts it beyond the outer circle of this pitfall. It forms these cavities by shuffling backwards with its pointed abdomen in a spiral direction, rejecting, as it proceeds, the superfluous sand, by a jerk similar to that by which it throws off the cases of the insects it has devoured. It is a short plump creature, with the head flat above, but convex beneath; and the mandibles are slender, forcipate at their extremity, and nearly one third the length of the body. It has six short slender legs; the posterior pair being distorted in position, to facilitate the peculiar regressive motion by which it forms its burrow. When arrived at maturity, it forms a circular cocoon of silk, by means of the spinneret at the apex of its abdomen; and, after a short period, the insect itself comes forth, and is disproportionately large compared with its pupa; for, after quitting the case of the latter, it rapidly expands until it has acquired its full size; when its parts harden, and it sails forth to revel upon the nectar of flowers, for it has now lost its carnivorous propensities, and its life henceforth is a "perpetual feast of nectar'd sweets." Réaumur has observed, that they will feed upon fruits, especially plums. A further confirmation of the striking differences between the preceding and the present families is, that the latter rarely fly during the day, but chiefly towards evening; and, in repose, their wings are roofed over them like those of moths; whereas the former fly only during the brightest sunshine, and the position of their wings has before been shown. Closely allied to *Myrmecoleon* is the genus *Ascalaphus*. Their larvæ are considerably alike, but they do not, like those of the former, make conical traps; and, besides, their progression is forwards, and not backwards. The perfect insect is extremely like a butterfly; it has antennæ as long as the body, which are suddenly knobbed at their extremity; their wings are more or less triangular, and variously spotted or marked; but they have a slow and heavy flight.

(302.) Our next sub-family, the PANORPINÆ, are peculiar for the possession of an elongated rostrum, at the apex of which is the mouth; and in the typical genus *Panorpa* itself, the abdomen is lengthy, attenuated, and recurved, the terminal segment being considerably swollen, and having prehensile chelæ at its extremity in the male. From the resemblance of this appendage to the tail of a scorpion, they are called scorpion flies: they occur abundantly in meadows, about the summer solstice; and, although so common, they are unknown in their larva state. In this same family, we observe the apterous small Northern genus *Boreus*, in which the ovipositor of the female is formed not unlike that of a *Gryllus*, and their males only have the indication of wings. This genus occurs in the northern parts of this island, usually during the winter, and it has even been caught tripping along upon the snow, at a period when complete torpidity suspends the animation of the rest of the insect world; excepting only, also, the little apterous *Chioneæ*, another Northern genus, but belonging to the circle of the *Diptera*, which is found almost exclusively upon the snow. We here, in this sub-family, further observe the long-legged genus *Bittacus*, and the long-winged *Nemoptera*; the former resembling a *Tipula*, but having four wings of equal size. In *Nemoptera*, the anterior wings are large, and nearly circular; and the posterior pair very long and filiform, being usually at least three times the length of the body: in the form of its proboscis, this genus makes the transition to *Chorista*, and thus conveniently associates here instead of in connection with *Myrmecoleon*; for *Chorista*, although in all the other particulars of structure it resembles *Panorpa*, has not the prolonged rostrum of the latter. It is a native of New Holland, that world of wonders in its animal and vegetable forms.

(303.) Passing to our next family, the TERMITINÆ, we come to the only tribe of insects out of the circle of *Hymenoptera*, which exhibit social habits. Man measures every thing with direct reference to himself; and as it promotes his good or ill, so does he pronounce upon its worth or worthlessness. We admire the economy of the bees, and speak with rapture of the industry of the little chemists which gather those stores of the fields, that, but for them, would evade our acquisition, and we then fraudulently rob them of their hard-earned treasures; but we execrate the devastations of the *Termes*, although it is the self-same impulse which directs the energies of each. "Man, in his tyranny over Nature and Nature's free denizens, forgets the justice of the retribution, and exclaims against it as an evil, heedless of the multitudinous evils which his own pravity scatters around, a[illegible] which frequently have no object beyond their wildness. But he must here submit, and with patience suffer what his sagacity can rarely avoid; and to prompt this, he must see in it but another instance of that general law which imbues all creatures with the instinct of self-preservation and the ardent love and protection of their young,— that universal στοργὴ which overcomes all obstacles, and is resistless in its effects. These insects form very large communities, consisting of individuals of four different kinds of winged males and females, and of soldiers and neuters which are apterous. In the former, the four wings are equal, with the neuration of the disk obsolete,—a character not found elsewhere among the *Neuroptera*; and the apterous individuals have strong mandibles. There is some diversity of opinion respecting the latter; and naturalists are not decided whether they are the preliminary stages of the insect, or independent and perfect states of existence: they, however, constitute the major part of the community, and execute all its labours. The information that we possess upon their internal economy is very imperfect. All that we know as certain is, that the different species construct different nests made of a kind of hard mortar, consisting of earth or sand agglutinated together,— some of which are like a cluster of sugar-loaves of different sizes,— the largest being eight or ten feet high; the nests of others are cylindrical, and are not more than two feet above the ground, with a roof extending on all sides beyond the lateral walls; others, again, build in the upper branches of trees, sixty or eighty feet from the ground; and in countries where trees abound, they excavate and occupy their interior. These insects always work under cover, and, unless by accident, they are never exposed to sight; and they thus construct subterranean galleries from their nests, wherever their destructive propensities incline them to wander; and in attacking houses, they eat into its timbers, gnawing their galleries longitudinally in its centre, leaving only the external crust; and thus, when their depredations have been extensive, not an article of furniture in a house is free from this dilapidation, and upon the least forcible touch, or first wind, all falls to pieces. The fecundity of the females is truly astonishing; and she is as much an object of solicitude to the workers, as is the queen among the bees. She and her partner are incarcerated in a cell by the neuters, and they are there regularly supplied with food; and after impregnation, upon the enlargement of the ovaries, her abdomen swells to the enormous size of 1500 or 2000 times the rest of the body; and as soon as she begins to lay eggs, these are conveyed away by the neuters to their prepared cells, which, in conjunction with their magazines of provisions, occupy the interior of these nests. It is said that she lays as many as 80,000 of these eggs in the course of twenty-four hours,—a fecundity that would speedily overwhelm the earth, were it not provided that but comparatively few reach maturity, and the great majority serve as food to birds, and beasts, and fishes; and the natives, also, of the tropical regions where they occur, cook them and eat them as a delicacy. From the great resemblance of their manners to those of ants, they have been called "White Ants." But the true ants are their mortal enemies, and prey upon them with the greatest voracity, especially at the period of their swarming, at the commencement of the tropical rains,—the only time when they voluntarily make their appearance abroad. Although, probably, all are of tropical origin, a few species have located themselves in the South of Europe; but it is to be hoped that the temperature of our climate is too variable and cold to suit the constitution of these insects; and although commerce has imported many evils in concurrence with its benefits, we heartily deprecate the possible introduction of such unwelcome guests. Other allied forms, but which are not social in their habits, are found in *Embia* and *Olyntha*.

(304.) The last sub-family of this first circle, the *Rhaphidiinæ*, have, in the structure of some of its constituents, a direct intimation of the proximity of the next circle; for the genus *Mantispa*, with its lengthened neck, and raptorial anterior legs, is a complete resemblance of *Mantis* itself. It has short clavate antennæ; but the elongated neck is also the characteristic of the family,—for the genus *Rhaphidia*, of which it is besides formed, likewise possesses it in a remarkable degree. The latter insect, in its larva state, is very voracious, preying upon every other insect it can seize upon; it occurs chiefly in woods, upon the stems of oaks. The genus is as yet known only as European, and all the recorded species we possess in this country. Of *Mantispa*, the greatest number of species appears to occur in America, although it is found all over the world excepting New Holland. Some of the species seem to indicate a strong affinity, in the structure of their wings, to the genuine *Orthoptera*,—the anterior half of those organs being occasionally semi-coriaceous, which is a departure from the otherwise exclusively membranaceous structure of those limbs throughout the circle before us.

(305.) We now enter the family of the GRYLLIDÆ; the first sub-family of which, the *Mantinæ*, contains two very different types of form,—namely, *Mantis* and *Phasma*. Their habits differ as much as their structure: the latter being herbivorous; whereas the former are carnivorous, and of a very sanguinary and rapacious disposition. They are long and slender: the head transverse and small, with a pair of long, slender, setaceous antennæ at the junction of the head and thorax: the latter is attenuated, but dilates immediately, forming a linear, parallel, somewhat flattened tube, with its sides margined; and which has an articulated flexibility at its junction with the mesothorax, and is more than a third the length of the body. Attached to this in front, and approximate to the head, are a pair of comparatively stout legs, the peculiar construction of which, adapted for the seizure and retention of prey, has acquired for them the name of raptorial. The insect itself being slow, and without much muscular energy, and its nature requiring a large supply of food, it is furnished with this organisation, that, when lurking insidiously about, its purpose is disguised under its form, which considerably resembles the parts of a plant, although not so much so as we shall observe in the *Phasminæ;* and when arrived within a convenient distance of its prey, it darts forth these limbs and captures it. To give them the power of greater expansion, the coxæ are elongated, being nearly as long as the femur; and the trochanters are so articulated, that they admit of great variety of motion. The tibiæ, which are half the length of the femora, fold back upon them, which admits of the two latter acting in concert as prehensorial organs; and that they may effectually secure their prey, they are densely serrated longitudinally with a double row of short and acute teeth; and the tibia is furnished, besides, at its extremity, with a long curved hook, and, together with the long tarsus, which is attached externally to the latter, thus acquiring additional and wider range of action, draw conjunctively within the scope of the raptorial apparatus their destined victims. A striking illustration of how easily man is deluded by hypocrisy and false appearances, is afforded by the variety of names and religious character this blood-thirsty creature has acquired in all countries that it inhabits. By the attitude it assumes when lurking for its prey, or advancing upon it—which is done by the support of the four posterior slender legs only, whilst the head and prothorax are raised perpendicularly from the body, and the anterior raptorial organs are folded in front,—it greatly resembles a person praying; whence in France it is called *le Prêcheur*; in Provence, *Prego-Diou*; and in other countries it has similar names. The Turk says it points to Mecca; and the Hottentot pays it religious observances. Burmeister acquaints us, from the information of Zimmerman, with some singular facts connected with the North American species, the *M. Carolina*. He says, a specimen he possessed "was caught on the 2d of October; on the 3d, it laid its eggs: this was noted down. I was now prepared to expect the death of my *Mantis*. This, however, did not take place; for she continued to devour daily some dozens of flies, and occasionally large grasshoppers and young frogs; and it even consumed lizards three times its own length, as well as many large fat caterpillars. By this abundant fare, its abdomen began to swell considerably; and on the 24th of October, it laid eggs a second time; and after this business was over, which occupied several hours, it recommenced feeding upon every living thing that was put in its way: its abdomen swelled up again, and I fully expected to see it lay eggs a third time; but this was doubtlessly prevented by the increasing cold of the November nights; and in December, I observed that the tarsi of the creature had dried up and become useless. Its death now evidently approached, and this took place on the 27th of the same month. Whether it was impregnated before it came into my possession, I do not know; but from the beginning of October to the end of December, it lived solitary in a glass. The eggs of the first generation were hatched upon the 26th of May of the following year. An interval of three weeks had elapsed between the laying of the first and the second lots: I therefore thought a similar time would intervene between their hatching; but in this I was deceived, for the second brood left their shells three days after the first, viz. on the 29th of May. I now had my room full of young *Mantes*. I fed some with small flies, and their actions and mode of feeding were precisely like those of the older ones." The antennæ of the males of some are bipectinated, as in *Empusa*, *Blepharis*, and *Harpax*; and the resemblance to vegetables is considerably increased in others, by the foliaceous appendages of their legs and prothorax, as in *Hymenopus*, *Phyllocrania*, &c.; and this resemblance is enhanced by their usually green or grey colours, and it is rarely that they exhibit a metallic brilliancy; the genus *Metalleutica*, however, displays this peculiarity, especially in a species we possess from New Holland, although the genus is usually Indian. These insects have a wide geographical range, — being found in all the hotter regions of the earth: the extraordinary little *Eremophila*, with its abbreviated elytra, appears, however, confined to Northern Africa, and the contiguous parts of Asia, where they are the inhabitants of the most arid sandy wastes,—skipping about upon the surface of the burning sands, as the *Hydrometræ* do upon the water.

(306.) In the extraordinary peculiarities of personal appearance, the *Mantinæ* are far surpassed by their near neighbours, the *Phasminæ*, in which vegetable resemblances are quite complete; for their wings and their elytra are frequently perfect leaves, as in *Phyllium siccifolium*; and where this is not the case, the body is lengthy and cylindrical, like a dry stick or straw. The latter form is strongly exhibited in *Diura Chronos*, a native of Van Diemen's land, — an insect in which the body is eight inches long, and which has very small wings; others are totally apterous, as in *Bacteria* and *Bacillus*. In *Ectatosoma tiaratum*, and *Eurycanthus*, monstrosity reaches its acme; the former has dilated spined legs, a swollen body, with foliaceous appendages also spined. In others, again, the male is winged, and the female apterous. *Cyphocrania* exhibits species with the largest wings, and also the longest insects; and their wings are usually of a delicate rosy tint: but we must hasten on to the *Gryllinæ*, which, although forming a small group, are of a very marked character. They are usually robust. In *Schizodactylus*, a native of China, the tarsi are elegantly lamellated laterally; the tibiæ are very spinose; and the extremity of their hemelytra are beautifully convoluted. The domestic cricket belongs to this group, whose cheerful chirp enlivens the farmhouse hearth. Here we have also the remarkable *Xya*, which, like *Gryllotalpa*, is a burrowing insect: but in the latter, the extraordinary palmated anterior tibiæ, very like a dilated hand and fingers, — the structure requisite, as in that of the mole, for it burrowing habits,— reaches its highest perfection, and to which we find a sort of analogical resemblance in the anterior tibiæ of the burrowing *Carabidæ*, and in the structure of the prothorax in the genus *Chiron*. The little *Sphærium acervorum* is an inhabitant of ants' nests: its four anterior legs are slender; it is quite apterous; and has, perhaps, the most largely developed posterior femora throughout the circle. It is supposed that it feeds exclusively upon the roots of plants. Equally apterous is the genus *Cylindrodes*, an elongate cylindrical insect, and one of the most extraordinary forms throughout the group.

(307.) In the *Locustinæ*, we find in the genus *Pterochroza*, a remarkable similitude to many of the *Phasminæ*, in the resemblance of its elytra and wings to leaves, but from which group its saltatorial legs remove it. It is difficult to draw the strict line of separation between these and the preceding group, excepting, perhaps, in the number of the joints of the tarsi, which are here four; their antennæ are equally setaceous, which separates them from the *Acridinæ*: they are usually more compressed in form, and less robust; their tarsi, besides, have a vesicular sole. In some, as *Bradyporus* and its allies, the head is exceedingly large, and in *Anostostoma*, insects from New Holland, there is a remarkable development of the mandibles. In the division with smaller heads, we observe the remarkable *Acridopeza*, also from New Holland, in which the female is short, convex, and ovate, and the male elongate and slender. It is in the genus *Decticus*, belonging to this group, that we find the species called *verrucivorus*; which has its name from being used as a specific to eat away warts: possibly this is effected by the acrid secretion it instils into the wound it makes with its mandibles: and it is the closely allied typical genus *Locusta* which offers us, in the *viridissima*, our largest native species.

(308.) The next family, the *Acridinæ*, constitute the true grasshoppers,—insects whose song and vivacity give cheerfulness to the noontide languor of a summer's day. They are distinguished chiefly by their antennæ being shorter than half the length of the body, and distinctly articulated; the posterior legs being always saltatorial; their tarsi three-jointed, and all the tarsi alike. Some are apterous, as *Batrachotetrix* and *Proscopia*,—the latter very much resembling one of the stick-like *Phasminæ*. There is greater uniformity in the structure of their wings than throughout the rest of the circle, and these organs in repose form a very compressed roof over it; and the four are always of the same length; the true wings having frequently considerable expansion, and are often gaily or gaudily coloured,—sometimes being of a bright scarlet, or of a rich purple, as are the insects themselves, although greens are the prevalent tints. A leading characteristic in these insects is doubtlessly the diversities of structure observable in their prothorax, which, in *Acridium*, is usually produced, posteriorly, as long as the body. In *Truxalis*, the antennæ are fusiform, and the head is remarkably formed, having the forehead considerably produced; and in *Pneumora*, the abdomen is inflated into a large semitransparent bladder: but the *Œdipoda migratoria* is the species which has obtained the widest celebrity, from its assumed migratorial and destructive habits. The narrative, as regards their flying to considerable distances, is possibly fabulous; but there is no question that in some years in which they have acquired excessive prolificness, they may make destructive excursions. All books on entomology are redundant with its history: we shall, therefore, on account of our limited space, proceed to the *Blattinæ*, which, probably, would more properly come into our third family. These are distinguished by their elytra lapping one over the other, and being entirely coriaceous, beneath which the wings are folded longitudinally: their antennæ are setaceous, and their legs all cursorial, with pentamerous tarsi. Some genera, as usual, are entirely apterous,—at least, winged individuals have not yet been seen belonging to them; and this is the case in the New Holland *Polyzosteria* -one of the largest insects of the sub-family, and which is of a bronzy metallic tint. In *Perysphæria* and *Heterogamia*, the male is winged, and the female apterous. The majority, however, are winged insects in their final condition. They are lucifugous, and feed chiefly at night. Commerce has introduced many species to our sea-ports, some of which have gradually spread all over the country; two of which especially, the common black beetles, the *Periplaneta Americana* and *Orientalis*, are found in kitchens and warm cupboards where provisions are kept: when at large, they generally occur in obscure places or beneath stones, and sally forth, after night-fall, in search of their prey. They are usually of a bright or dark brown colour: some are livid or testaceous, as, for instance, *Blabera gigantea*, which is the largest in the circle; and a few are gaily coloured, as in *Corydia* and *Phoraspis*. We find at large, in our woods, and beneath stones, the *Blatta Laponica* and *Germanica*. The remarkable capsule which contains their eggs, is a phenomenon occurring no where else in the insect world, as it is formed within the abdomen of the female: it is an oblong, flattened brown sheath, within which the eggs are deposited in two rows; and the female carries this attached to her abdomen until the eggs are nearly mature, when she lets it fall, and the compressed edge bursts open, and the young creep forth with the shell of the egg still adhering to them.

(309.) Our next family, the **Forficulidæ**, is a group of still smaller extent, which are known by the name of earwigs, and are distinguished by their abbreviated parallel elytra,—thus resembling the *Staphylinidæ*, and whereby the *Coleoptera* and *Orthoptera* seem in some measure connected; and also by their elegant delicate and expansive wings, which in repose fold in radii diverging from a nearly central spot. Their tarsi are trimerous; and the apex of the abdomen is furnished with a couple of elongate curved horny processes, which are usually forcipate and capable of being used as prehensile organs, being articulated at the base: the antennæ are setaceous, and variable in the number of the joints. Some, like some of the *Blattinæ*, are apterous. These peculiarities and differences of structure have led to generic subdivision. The female covers her eggs as assiduously as a hen; and a similar instance of this brooding we have already observed in the *Hymenoptera*, in the genus *Perga*. The *Forficulæ* are very destructive in gardens, to flowers and fruits, which they much deface; but the bad reputation they have acquired, and which their vernacular name implies, is not merited, and the circumstance totally fabulous. It is unfortunate that such reprehensible mistakes should exist, as those which attach to very many insects; for they tend to foster prejudices which necessarily obstruct the progress of knowledge, by making objects abhorrent to inspection, which, when investigated, present as large, but a more readily accessible, field for instruction, delight, and amusement, as any throughout nature; none of which, however, surpass, perhaps, the extraordinary little parasites which form the contents of our next sub-family,—

(310.) The **Stylopidæ**, or *Strepsiptera*. The situation of these insects is one of perplexing interest. They are parasites upon some of the genera of bees and wasps; and the peculiarities of their structure and economy have made them a problem which entomologists have not yet solved. The first discovery of one of these insects was made by Rossi, who found it upon the *Polistes Gallica*, and established for it the genus *Xenos*; and Mr. Kirby subsequently observed a *Stylops* emerging from its obtected pupa-case between the abdominal segments of an *Andrena*. The whole structure of these insects is very remarkable; their antennæ are either auriculated, as in *Stylops*; furcated, as in *Xenos*; or flabellated, as in *Halictophagus*; and robust, compared with the insects: their head transverse, with sub-pedunculated eyes, consisting of comparatively few and separated hexagons. The mouth is of singular structure: the mandibles are apparently obsolete; it has no obvious labrum; the labium and mentum are invisible; and its trophi are reduced to apparently a couple of setiform maxillæ, with an enormously large two-jointed maxillary palpus affixed externally at their base; the prothorax is transverse and narrow; the mesothorax also narrow, with a couple of lateral distorted articulated appendages, the analogues of elytra; and the metathorax is very largely developed, occupying more than one half of the insect; and this gives room for the exercise of the large muscles required for the movement of its expansive semicircular wings, which fold longitudinally in repose, and rest upon the body. These are without nervures, although there is a slight indication of something like them, somewhat analogous to the irregularity of neuration we find in the wings of the *Coleoptera*; and we strongly incline to the opinion, that they have considerable analogy to the eccentric genus *Atractocerus*, where we have also a greatly enlarged metathorax, wings folding longitudinally, and minute and all but obsolete wing-cases. The tarsi of these insects vary in the number of their joints, from two to four, and these are all furnished beneath with a vesicular cushion, and they are without terminal claws. These insects fly with a sort of undulating motion, and are very conspicuous objects in the clear sunshine. Their sexual differences are unknown; and it is assumed that those hitherto described are all males, and that possibly the females are apterous:

this point, and many other particulars relative to them, are still involved in deep mystery, which time and careful observation only will elucidate. We place them in this circle, as its most aberrant group.

(311.) We now enter our fifth circle, comprising the group of the PHRYGANIDÆ,—the majority of which, in their preliminary stages, inhabit the water; and throughout the whole of which we find a uniformity of texture in their four or two wings,—which peculiarity we quitted in leaving our first circle, the *Libellulidæ*. The first sub-family of these constitute the *Ephemerinæ;* the brevity of the lives of which, in their perfect state, have furnished moralists with a comparison for the shortness and vanity of the life of man. In many particulars of structure, these insects bear a strong affinity to the first sub-family of our first typical circle of the *Neuroptera*, viz. the *Libellulinæ*. Like them, these are destitute of palpi; and they have short, subulated antennæ, and they likewise exhibit a large developement of the eyes: in their wings, however, we observe a considerable difference; for in the present sub-family, the secondary wings are considerably the least in size; and, as a necessary consequence, there is a smaller developement of the metathorax,—the reverse of what we find in the *Libellulinæ;* but these wings are always expanded, and never folded. In the *Ephemerinæ*, we observe considerable sexual discrepancies in the length of the anterior elongated legs, which are protruded forwards, and evidently serve, as in some of the gnats, for organs of touch; and the apex of their abdomen is furnished with two or three lengthy and articulated setæ. There is much resemblance between the larva and the perfect insect. These larvæ breathe by branchiæ, and they occupy burrows formed in the mud of the banks of the streams wherein they dwell: they feed upon the larvæ of other insects, or animalculæ, which they bring within their reach through the motion given by their branchiæ to the water: they possess very large mandibles, which, besides assisting them in the capture of their prey, enable them to make their burrows. They possess three long legs attached to their large thorax, all of which are bent forwards: their branchiæ are affixed on each side of the abdomen; and of these there are usually seven pairs, which occupy the place subsequently held by the stigmata in the perfect insect; there are varieties of structure in these organs in the several genera of which the sub-family is composed. Swammerdam informs us that they are three years in acquiring their full growth; this is a remarkable circumstance, considering the shortness of their lives afterwards. Having grown to maturity, in which state anglers make use of them as a bait, they quit their burrows, swim to the surface, where their enveloping case splits, and from which the insect extracts itself with expanded wings, and flying to some neighbouring object on the shore, again uncases itself; for, although it has already acquired its wings, and the power of flight, a delicate membrane still clothes it,—of which, however, it speedily divests itself. The insects sometimes abound in such profusion, that the air is completely filled with them, and their dead bodies have been strewed over the land as a rich manure; for their life terminates with the execution of the function for which they were solely transformed, — that of perpetuating the species,—which is almost instantly accomplished. The chief genera are *Oxycypha*, with only two wings; *Cloe*, with four, but the posterior extremely minute. *Baëtis* and *Ephemera* have the inferior wings larger; but the former have three ocelli, and the latter but two.

(312.) Our second sub-family, the *Phryganinæ*, is of much larger extent than the preceding, and they are known as "May flies." They constitute the order *Trichoptera* of Kirby. Of all insects, they approach the closest in resemblance to the *Lepidoptera*, — their wings being covered with hairs, or narrow scales; and in their transformations, also, they have a considerable resemblance to that order; from which, however, they are sufficiently distinct in having a mandibulated mouth.

They have long setaceous antennæ; their wings are of an unequal size, and are laid in repose, like those of a moth, over their back; their legs are usually long, and their tibiæ are variously furnished with spurs half way up its shank. In their larva state, they reside in cylindrical cases,—but which, in *Hydroptila*, are kidney-shaped,—which are composed of a variety of substances, as bits of stick or straw, or of small shells, or sometimes of small stones, which are attached together by a silky substance spun by the larva. The majority are conveyed about, either by the motion they can themselves give to their case, or by the current of the water; and other cases are permanently affixed to stones beneath the water; and it is probable that, upon each change of skin, a fresh case is made. Like most aquatic larvæ, they breathe by branchiæ. Unlike the majority of the rest of the *Neuroptera*, these larvæ are very dissimilar to the perfect insect, and which, extracted from its case, is a soft worm-like creature, with the anterior segments somewhat horny. Their branchiæ are placed along each side of the abdomen; they are setiform, and are usually arranged in stars, radiating from a centre. Their anal segment has appendages which, as their cases are open at each extremity, admit of their being used as feet, but which vary in structure in the genera. They are indifferent in their diet, feeding as willingly upon aquatic plants as upon other insects, and they are excessively voracious. They are but one year undergoing their transformations, and to effect this, they close both the apertures of their cases. They undergo a complete metamorphosis; and the perfect insect then flies forth to feed upon the juices of flowers; and when impregnation has taken place, the female deposits upon some water plant a mass of eggs enveloped in a thick jelly-like substance. The most remarkable genera are *Acentropus* and *Hydroptila*, in which, possibly, the resemblance to the *Lepidoptera* is the strongest. In *Mystacides*, the antennæ are excessively long: in *Barypenthus*, and in *Sericostoma*, the middle spurs of the tibiæ are wanting; and *Phryganea* itself exhibits the largest species.

(313.) Our next sub-family, the *Hemerobiinæ*, offer less harmony of general structure, either in the perfect insect or the larva. These insects are usually called lace-wing flies, from the elegant reticulation of those organs, which are of comparatively considerably larger dimensions; and they differ from the last in having the trophi free. They have rarely ocelli, and their eyes have considerable metallic brilliancy: their legs are short and slight, and their tarsi pentamerous. Their larvæ are not aquatic, but they are very ferocious devourers of small insects; this we have particularly observed in that of *Chrysoperla*; and we have further observed, in the transformations of this insect, that the pupa creeps to some distance out of its cocoon when ready to undergo its final change, and then casts off its pellucid skin, and emerges as the perfect insect. *Hemerobius* has usually its wings covered with minute hairs, and *Osmylus* has them beautifully spotted: the latter is remarkable, also, for the possession of ocelli,—a circumstance of rare occurrence in this sub-family. Although possessing large wings, they fly heavily, by slowly flapping them, and their flights are very short. They occur usually in hedges skirting brooks. Their transformations approach closer to those of insects with a complete metamorphosis; and there is less resemblance between the larva and the imago, than in any of the preceding sub-families, excepting only the last. It is in this same sub-family that we arrange *Sialis* and its allies, *Chauliodes* and *Corydalis*: of these, the larva of the first only has been observed, and which is aquatic; it is a common native. This larva is furnished with branchiæ, as in the *Phryganinæ*, and which are arranged somewhat similarly to those insects,—being attached to the seven or eight first segments of the abdomen, but ciliated; it is gradually attenuated posteriorly, and has a single caudal appendage; and, like those insects, it is probably carnivorous. *Chauliodes* and *Corydalis* are both North American genera, and are of conspicuous size compared with the rest of the sub-family; all that are yet known exceeding an inch in dimensions. The former is distinguished for its pectinated antennæ; and one species of the latter, the *C. cornuta*, has, in the male, largely developed mandibles,—whence it has derived its specific name.

(314.) The *Perlinæ* are our next sub-family. These insects possess four narrow naked wings, of which the inferior, in repose, are folded: the nervures are wider apart than in the majority of the preceding sub-families; they are almost always obscurely coloured: the insects are of a depressed form, with a large quadrate head. They fly rarely, and are very inert, allowing themselves to be readily captured. Their larvæ inhabit the water, where they move by the rowing of their legs; and they feed upon other small insects: they are more than a year undergoing their changes; and when they have attained their maturity, they creep up the stem of some water plant, and there quietly await the bursting of their skin, which speedily takes place down the centre of the head and thorax; and the perfect insect then creeps forth, and flies off as soon as its wings are thoroughly expanded. It is remarkable, that the males are incapable of flight, owing to the frequent shortness of their wings; thus reversing what is usually the case in insects, of the females being the least provided with these organs, when such a sexual disparity exists. *Nemura*, *Perla*, and *Eusthenia* are the chief genera. The last is a native of New Holland.

(315.) Our next, and the last sub-family, the *Psocinæ*, is of equally limited extent. They are minute insects: when winged, the wings are unequal in size, the anterior being considerably the largest, and they are loosely covered with nervures. The typical genus, *Psocus*, occurs about the stems of trees and on palings, and is said to feed upon lichens. It is contiguous to these insects that the genus *Atropos* is placed, and which contains the so celebrated book-louse, famous for its reputed ticking, whence it has also been called the death-watch; which is doubtlessly a fable, as it is more than probable that the noise is produced by an *Anobium;* for it is scarcely possible that so small and delicate an insect as the *Atropos* should cause so loud a sound. These insects are apterous, and are very destructive in neglected collections of insects or plants; but they are readily destroyed by the smell of camphor. Although it occurs frequently in old books, especially those which have been exposed to damp, it either seeks their paste, or the minute fungi developed by the moisture; and those holes, so frequently found in such books, must be attributed to the larvæ of the *Anobia,* and other beetles of similar habits. Only one exotic genus (*Thyrsophorus*) of this sub-family is known. It is peculiar to the Brazils; whereas the others are all natives of our own country. [(299—315.) W. E. Sh.]

PART III.

ON THE CLASS OF APTEROUS INSECTS.

CHAP. I.

ON THE APTERA GENERALLY.

(316.) THE second, or sub-typical, class of annulose animals is the APTERA of Aristotle: which is connected to the *Ptilota* of the same immortal zoologist by the order of *Diptera*. The general reader will readily understand this class, on being told it contains the different families of the spiders, centipedes, scorpions, crabs, and other wingless groups, together with the flies; which, as standing at the confines of the whole, connect the apterous orders with such as are provided with four wings.

(317.) Our definition of this group, in its primary or typical characters, is in accordance with those of Aristotle, Linnæus, and Fabricius,—three names quite sufficient, if science reposed upon mere authority, to counterbalance all those of modern times who hold opposite opinions. As we have simply defined an insect to be a creature which moves on the earth by means of jointed legs, so do we comprehend under the name of *Aptera*, all such as are either destitute of wings in every stage of their existence, or which have, in their adult state, only two. Like the typical insects, they are all more or less subject to metamorphosis, but in different ways; for this change is a primary character of the typical *Annulosa*, and is even extended to one of the aberrant classes,—namely, the *Cirrhipedes*, or barnacles.

(318.) Before we enter further into this subject, it may be as well to examine the validity of the grounds upon which the moderns have ventured to break up the *Aptera* of Aristotle, and thus to render their definition of an "insect" perfectly unintelligible to the world at large. We will first endeavour to meet their arguments upon general principles, and then to oppose them upon other grounds. The French naturalists, Cuvier and Latreille, upon discovering that the *Crustacea* breathed by branchiæ, at once separated them from insects, properly so called; thereby assuming, that the mode by which an animal breathes was, among the *Annulosa*, the primary character to be looked to, and upon which we were to decide what was, or was not, an insect. Now, it is against this assumption, which is the very root of all the modern changes introduced in the arrangement of the annulose circle, that we take our stand. We deny it is either logical in itself, or borne out by facts. It is illogical, because it sets aside all the most prominent distinctions by which insects are characterised from other classes; and makes that a primary principle of separation, which does not even enter into the definition of an annulose animal. If it be true, that the *Annulosa* are characterised by their body and limbs being articulated, by being provided with distinct feet, and by undergoing a metamorphosis; which, in the preeminent types, gives to the adult insect the powers of flight; how, let us ask, can their mode of respiration be placed higher than all these? How can it be brought in for the construction of primary divisions, when it forms no part of the primary characters of the *Annulosa*? The natural divisions of a group, such as this, are indicated by the modifications of those characters which are applicable to the whole; and this we see is actually the case, not merely with regard to insects, but to all classes of animals. Thus, in the *Ptilota*, they are all developed; in the *Aptera*, the metamorphosis is imperfect, and the wings disappear; in the *Cirrhipedes*, there are no true legs, as in the former; and finally, there remains, in the *Vermes* and the *Annelides*, only the annulose body (and this often very obscurely), to indicate their connection to the annulose circle. The very principle, therefore, of introducing the mode of respiration as a ground for founding classes and orders, is radically vicious and unphilosophical.

(319.) The effect of attaching this imaginary importance to the respiratory organs of insects, has led to all that confusion and opposition of opinion, which might naturally have been expected. The integrity of the *Aptera* being once destroyed by the separation of the *Crustacea*, and the principle being unthinkingly admitted, innumerable other dislocations followed. New classes and new orders were proposed, and attempted to be defined, by all who built their systems upon *respiration;* and this was pushed so far that the entire distribution of the *Annulosa* has actually been made to hinge upon this single circumstance.* In proportion to the multiplication of these new "classes," so was the disunion of sentiment among those who advocated the respiratory system; they neither agreed, in fact, with each other, nor with themselves. Dr. Leach changed his System of the apterous groups two or three times; Latreille has done the same; and ultimately we find Messrs. Kirby and Spence rejecting all these, and proposing a division called *Aptera,* which they themselves are dissatisfied with, as not a natural, but a provisional order. No wonder, therefore, that all these conflicting theories "have much perplexed systematists," who really seem to have become bewildered by their own refinements.

(320.) Now, it would be well to ask, whether the respiratory theory of entomologists is supported by any analogous instances in other classes of animals? and whether the possession of gills, or sacs, or tracheæ, have been looked upon, by zoologists in general, of sufficient importance to create distinct classes or orders? No such instance, in fact, can be cited. Cuvier, indeed, has done this in the case of the *Syngnathidæ* among fishes,—a single genus, which, because its branchiæ are in tufts, instead of being pectinated, as in most of the other osseous fishes, he detaches as the type of a distinct order; and yet the genus *Heterobranchus*, which has two sorts of branchiæ*, (a structure unexampled among the whole class of *Pisces*,) is left with its natural allies, and is only distinguished as a genus in the family of *Siluridæ*. Among the testaceous *Mollusca*, again, the variations in the mode of breathing are still more remarkable; and yet they are considered but of very inferior moment, when compared with other points of structure. Still more is it apparent in the class of *Amphibia*, where we find the branchiæ external in one group, internal in another, and absent in a third; while, among the salamanders (*Urodela*), the young have external branchiæ, and the adult is furnished with cellular lungs. The frogs (*Anoura*), when tadpoles, have external branchiæ, which disappear in the perfect animal, and become internal. The whole of the Animal Kingdom, in short, exhibits instances of this. It has been observed by a well-known writer, that Cuvier never made a more palpable mistake, than when he attempted to arrange the *Mollusca* according to their several systems of generation and — respiration.

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* See Dr. Leach's arrangement, as given in Samouelle, *Entom. Compend.* 75.

(321.) Reverting, then, to the enlarged views of the early writers relative to the *Aptera*, we shall at once look to the class before us as composed of the five following orders, whose relations to the corresponding group of *Ptilota* will be subsequently noticed: — I. The ARACHNIDA, or spiders, consisting of insects whose head is confounded with the thorax, and whose mandibles assume the appearance of fangs, or hooks, from which they are capable of ejecting a poisonous liquor: the body is generally short, oval, and pedunculated; and the legs are eight.—II. The MYRIAPODA, or centipedes, having the body greatly lengthened, the head distinct, and a great number of feet.—III. The CRUSTACEA, or crabs, which are enveloped by a hard or crustaceous covering; live in the water, and breathe by branchiæ; the head being apparently confounded with the thorax.—IV. The SUCTORIA, or fleas: the body is compressed, and covered transversely with hard and polished plates, and with four minute scales, which indicate the position of the wings of flying insects.—V. The DIPTERA, or two-winged insects, which, like the last order, imbibe their nourishment by suction.

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* Classification of Fishes, i. 350.

(322.) The isolated position which belongs to the fourth of these orders, is, we apprehend, entirely caused by the fact of its containing not more individual species than would form a sub-genus, while, in itself, it ranks as an order: this rank has been assigned to it ever since the days of De Geer, who was the first writer that thus detached it; and whose name of *Suctoria* we shall retain, in common justice to so great a man. We shall not enter into the conflicting opinions of the moderns relative to the situation of these singular insects; for a chapter might be so filled, and the reader, in the end, left pretty nearly in the same state of uncertainty as at first. We would simply call the attention, even of the most unscientific, to those little crustaceous insects so common among sea-weed on sandy shores, and then ask him what insects can possibly be more like, in habits and appearance, than these are to fleas? their very name of *sand fleas* at once shows that this resemblance is so strong that every body perceives it; and however the two may differ, when we come to anatomical details and technical refinements, these will never alter the similitude, or persuade an unscientific person that they do not come wonderfully near to each other. We consider, therefore, that the order *Suctoria* is more clearly related, by affinity, to the *Crustacea* than to any other; but this being admitted, we confess our entire ignorance of what resemblance it has to the *Diptera*, beyond the fact of both being perfectly suctorial orders. The only great hiatus, or interruption, therefore, of the circular succession of the *Aptera*, as here arranged, appears to be at this point; since the resemblance which certain extreme *Crustacea* possess to such forms as *Oniscus*, renders the union of both sufficiently clear. From the *Diptera*, therefore, to the *Arachnida*, the passage is at once opened by *Nycteribia*; from the spiders to the centipedes, and from these to the *Crustacea*, the line of affinity is preserved; while what has been said of the resemblance between the marine and the land fleas, is all but demonstrative that the whole form a circle, — since the situations of *Diptera* and *Suctoria* are established, not by their own union, but by their connection to the orders which either precede or follow them.

(323.) We now come to the analogies, which may be thus exhibited as referring to the *Ptilota*.

Analogies of the APTERA *to the* PTILOTA.

Orders of the *Aptera.*	*Analogies.*	Orders of the *Ptilota.*
ARACHNIDA.	Sub-typical; feet the same in their larva and perfect state.	NEUROPTERA.
MYRIAPODA.	Pre-eminently typical of their own circles; feet variable in their larva and perfect state.	LEPIDOPTERA.
CRUSTACEA.	Head large. Aquatic.	NEUROPTERA.
SUCTORIA.	Body encased in hard plates.	COLEOPTERA.
DIPTERA.	Winged in their adult state.	HYMENOPTERA.

(324.) In our former volumes, we have had frequent occasion to notice the occasional transportation, as it were, of the analogies of the typical groups in two different circles; as a consequence of some variation in the dispositions of the groups, thus brought into parallel comparison, for which we were unable to account. We have before observed that the tendency of metamorphosis in the *Ptilota* is to give wings to the perfect insect; while, in that of our *Aptera*, it is to give an increase in the number of feet. Now, if this theoretically be true, the philosophical inference will be, that the *Myriapoda* are the types of the *Ptilota*;

for the first have the greatest developement of the feet, just as the other has of the wings. It is not a little extraordinary, indeed, that the first have the fewest, and the latter have the most, feet, in their larva state: here, then, is certainly an analogy, although it cannot be expressed succinctly in words. On the other hand, the *Iülidæ*, again, which are certainly the types of the *Myriapoda*, agree with the *Lepidoptera* in not being carnivorous; and this is a material point of similitude; so that we see the two pre-eminently typical groups agree in many important particulars: on the other hand, when we consider that the spiders and the lepidopterous larvæ, are the only insects having the power of spinning, we are tempted to believe, that they are true representations of each other; and that the *Myriapoda* represent the *Hemiptera* — not the *Lepidoptera*. We state all these circumstances, leaving the question to be decided by others, although we ourselves believe the former to be the correct mode of viewing the subject. The analogy which many authors, particularly MacLeay, conceive the *Suctoria* to have with the *Coleoptera*, is strengthened by the foregoing table; and it is quite clear they represent each other, just as the *Crustacea* typify the aquatic *Neuroptera*: as for the resemblance between the *Diptera* and the *Hymenoptera*, it is not merely an analogy, but an affinity,—and this so close as to be obvious to every one. The analogies, in fact, between the two great typical classes of insects, are so complete, as to leave no doubt that they are founded in nature.

(325.) The use of these comparisons, however, is not merely confined to the developement of analogies. They prove, if any thing can prove, the rank of the divisions belonging to each; and show, in the clearest manner, that if those in which the *Ptilota* are at first divided, are really orders, those of the *Aptera* are nothing higher. The *Neuroptera*, in fact, are as much entitled to be termed a *class*, in the usual acceptation of the term, as are the *Crustacea*; for structure, and not numerical amount, is to be looked to in all questions of this sort; and if the groups in equivalent circles correspond in some one or more characters, peculiar to them alone, they must be inevitably of the same value.

(326.) Having now endeavoured to place the primary divisions of apterous insects upon a more determinate footing than has hitherto been done, we shall not attempt to indicate, even by synthesis, the natural division of families which must belong to each. Our object is to indicate the road to natural arrangement, not to follow it up in detail. The groups of the *Aptera* we have adopted, are those of our predecessors: the only novelty consists in an attempt to determine their relative value, and to establish their relations to other groups. This done, we shall, in the following pages, merely give the general reader an idea of the insects contained in each, without any attempt at determining their limits, or the systematic order in which the families should stand.

CHAP. II.

APTERA, *continued.*

ON THE DIPTERA, ARACHNIDA, CRUSTACEA, MYRIAPODA, AND SUCTORIA.

(327.) Not having thoroughly analysed the families of which our circle of Aptera consist, we prefer giving a rapid sketch of its contents, as investigated by the latest and best systematists, to leaving the scheme imperfect by the omission. The first family comprised within this circle are the *Diptera;* and, although it may appear a contradiction to speak of so large an order of insects as the *Diptera*, under the general denomination of *Aptera*, yet, as they form the most aberrant subfamily in the circle, this difficulty is removed, as they constitute the direct point of contact with the preceding circle of the *Ptilota*. The *Diptera* comprise a host of insects, the most general character of which is to possess two membranous wings, with their disk variously occupied with longitudinal nervures and comparatively few transverse ones, these wings are affixed to the mesothorax, and are thus analogous to the superior wings of those insects which have four genuine wings, or to the elytra or hemelytra of those in which the superior wings are supplanted by such appendages. In addition to these two wings, and attached behind them, are a couple of usually clavated organs, having a moderate peduncle; these are called *halteres*, or poisers; they are articulated organs, but the uses of which are not known, although they may not be considered as analogous to the secondary wings of the other orders. In addition to these organs, very many possess a concavo-convex scale, which covers the halteres, and which is called the *alula*, or winglet. Being exclusively suctorial insects, and feeding upon liquids, their *trophi*, or organs whereby they take their food, consist of a flexible proboscis, modified in a variety of ways in the different families, but always analogous to the structure we have before described in mandibulated insects: thus, we find the *theca*, or sheath, which represents the labium, and which encases the proboscis; further, the haustellum, which consists most generally of two pieces analogous to the labrum; occasionally of two others, which are called the *cultelli*, or knives, which possibly represent the mandibles; and there are rarely two others, called the *scalpella*, which may remind us of the maxillæ; and there are, in addition to these, two palpi. It thus amply differs from the trophi of all other haustellate insects. These are the most general characters, whereby the entire order is distinguished. Within themselves, the modifications of structure which they exhibit, furnish the characters upon which their distribution is founded. The most prominent of these are supplied by their antennæ, which, considered typically, consist of but three joints; but, attached to the third, we frequently detect a setaceous appendage. In the first division, however, they have never less than six joints, and usually more than twelve. The eyes of the *Diptera* exhibit some remarkable peculiarities, and frequently sexual discrepancies: these organs, in the male, often occupying nearly the whole of the head; and they are often densely clothed with hair,—a structure that would almost seem to impede vision; and another singular circumstance is, that, although the hexagonal structure of the facets of which the composite eyes are composed is universal, yet the several families, genera, species, and sexes exhibit peculiar arrangements of different sizes of these facets in the same eyes; a fact, which, although exhibited by Hook in his enlarged eye of *Tabanus*, was left unnoticed by himself, and never, subsequently, observed or heeded by systematists or anatomists, although it displays such striking peculiarities.

(328.) The general integument of these insects is of as fragile a texture as in many of the *Neuroptera*, and the rest of their structure is perfectly analogous to the parts of other insects. All these structural particulars, however, undergo an infinity of modifications which are nowhere stationary; and the forms of their bodies are as variously different. These insects are usually oviparous, but they present two remarkable exceptions; for in *Sarcophaga* they are viviparous, or produce their larvæ hatched; and in the terminal division, the *Pupipara,* they are pupiparous, and bring forth their young advanced to the stage of pupæ,—and thus form a remote analogy to the marsupial animals. Under the several families, we shall observe other peculiarities incidental to the preliminary stages of their existence. The transformation of the majority into the pupa state is also very peculiar; for, instead of spinning a cocoon, or forming a cell, the skin of the larva hardens, and thus makes a case, within which the changes take place. In their perfect state, they are possibly not inferior to any order in the multiplicity of forms which they exhibit; whereas, in the abundance of individuals, they certainly surpass all; no place or time is unfurnished with them, and usually in enormous profusion Life thus multiplies life; for the multitudes of birds that they support, contributes to vary its extension over the earth; but the chief function that they exercise in the economy of nature, is to contribute towards the destruction of those substances which, in a state of corruption, would tend otherwise, by poisoning the air, to produce disease and mortality. Further peculiarities in their economy we shall briefly notice as we pass rapidly through the families; and we shall now, therefore, quit this generalisation, and proceed to the investigation of the contents of the order, and their distribution.

(329.) The two primary groups, the NEMOCERA and BRACHOCERA, into which they have been divided, according to the number of the joints of their antennæ, are of very unequal extent. The first, or NEMOCERA, are those which possess more than six joints to the organ, and comprises the *Culices* and *Tipulæ*. The former are perhaps the most highly organised, in every respect, of all the *Diptera;* and to the perfection of their suctorial apparatus the majority of us can attest, from our individual experience of what is called the sting of a gnat. Their larvæ are aquatic, and are those singular little red worms, large at one extremity, that we frequently observe in stagnant waters; they move by a sort of jump; and, breathing by means of anal tracheæ, they frequently resort to the surface, to imbibe a fresh supply of air. These are all small insects, and all the genera are natives of this country, but *Culex* is the most abundant in species. The *Tipulæ*, which form the second group, are less highly organised in the structure of their mouths only. The typical genera are well known as "Father long-legs;" and, in their larva state, many of them are very injurious to the roots of grass. They form a large tribe, subdivided by structure, but named from the places or substances they frequent. Thus we have Culiciform *Tipulæ*, terricole *Tipulæ*, fungicole *Tipulæ*, gallicole *Tipulæ*, and floral *Tipulæ*. They have been very aptly compared, from the multitude of tribes, genera, and species occurring in them, to the large coleopterous families of *Curculionidæ* and *Carabidæ*, wherein Nature exhibits an inexhaustible diversity, combined with a typical unity: but we must hasten on, with merely observing, that in the *Tipulæ* they exhibit to us the largest native *Diptera*; and in *Ctenophora* we find the most elegant structure of the antennæ, which are bipectinated, in the males, with alternate long and short branches. And in *Chironomus* we have the extraordinary instance of larvæ living in a social community at the bottom of ponds and brooks. We also find amongst them the remarkable little *Chionea*, which, as its name signifies, occurs only on the snow; and which, from its being apterous, has very much the appearance of a spider: and the North American *Bittacomorpha* is remarkable for the excessive incrassation of its tarsi. Among the fungivorous *Tipulæ*, the genus *Gnorista* has a singular elongation of its head and front; this produced portion being half as long again as the head itself. *Cecidomya* and *Lasioptera* are the representatives of the gallicole *Tipulæ*; and, like the *Cynipidæ* amongst the *Hymenoptera*, their larvæ live in the galls of plants, which the puncture of the parent insect forms; and it is amongst the former that the terrific destroyer of wheat is found, which is known in America by the name of the "Hessian fly;" as also in the tribe of floral *Tipulæ*, we find the genus *Simulium*, which use their anterior tarsi as feelers; and the number of the individuals of which, in some countries, is so great, that they become an oppressive pest to man and animals.

(380.) The second division, or **Brachocera**, have never more than three joints to the antennæ,—the last of which, however, undergoes a multitude of forms, and is usually accompanied with a style, or seta: they are subdivided into three smaller divisions, depending upon the number of setæ that accompany the oral apparatus; thus, the *Hexachætæ* have six, the *Tetrachætæ* four, and the *Dichætæ* two.

(331.) The first of these subdivisions, or HEXACHÆTÆ, comprises insects which, as their very name implies, possess a highly organised mouth; and consequently we observe amongst them those which feed upon the blood of the *Mammalia*, and for which purpose they were furnished with the apparatus of lancets their mouth contains. They are usually insects of a very robust form; and, by the subdivision of the third joint of their antennæ, they appear to indicate their proximity to the *Nemocera*. Their tarsi are furnished with three vesicles; and the reticulation of nervures of their wings exhibit high organisation. Amongst these are the *Tabani*, and their allies, *Hæmatopota* and *Chrysops*,—all blood-thirsty creatures, and which, in the woods, in summer, constantly alight upon the entomologist's face and hands, and put him to considerable pain. Indeed, it is related that Messrs Kirby and MacLeay were frustrated in an entomological excursion by the prevalence of these insects, against the severe punctures of which they could find no protection. These are all more or less distinguished for the excessive brilliancy of their eyes whilst alive, which surpass the most vivid gems in lustre, especially the latter genus, which deduces its name from the circumstance. *Raphiorhynchus*, named from its curved and produced clypeus, and *Acanthomerus*, which has spined femora, are large exotic genera peculiar to the Brazils; and *Pangonia longirostris*, in which the proboscis is several times longer than the body, is a native of India.

(332.) The second subdivision, the TETRACHÆTÆ, which are deficient in one pair of setæ to the mouth, have usually the terminal joint of their antennæ simple, or with an apical seta consisting of three divisions, which seem an obsolete indication of its previously developed structure. They have, further, but two vesicular soles to their tarsi, and their wings have less complication in their neuration than the preceding. They form a large host, and are divided into three families, viz. the *Notacantha*, the *Tanystoma*, and the *Brachystoma*. The first family, or *Notacantha*, are distinguished by having the third joint of their antennæ annulated,—thus somewhat resembling the *Hexachætæ*. They are all more or less characterised by the spines of their scutellum, whence their name; and they form three tribes—the *Sicarii*, the *Xylophaga*, and the *Stratiomyæ*. The larvæ of the second of these have been observed to live in putrescent wood. The Brazilian genus, *Hermetia*, in the same tribe, is peculiar for the pellucid spots at the base of the abdomen. *Xylophaga* is an extremely rare British genus. The third tribe, the *Stratiomyæ*, are all more or less attached to the water or its vicinity. Thus, *Stratiomya* is found only in such situations, and its larva occurs in stagnant pools; this is elongate, and depressed, and attenuated at the posterior extremity; and these insects are constantly found upon aquatic flowers; whereas the brilliantly metallic *Sargus* settles only upon foliage. The bodies of all these insects are considerably depressed, and their wings have a central, rather large, cell. *Ephippium* is of very rare occurrence as a British insect; and is of an intense black, with a bright red thorax: none of the family are of large dimensions.

(333.) The second family, or *Tanystoma*, contains the giants among the *Diptera*, and includes insects of great variety of habits and of forms. Their combining character is, however, to have the third joint of their antennæ simple, with a terminal seta; a coriaceous rostrum, which is usually slender and lengthy. The *Asilidæ* are probably the most typical; and are very rapacious insects, feeding upon every thing else that they can conquer. *Megapoda* is remarkable for its lengthy slender legs and large size, and is peculiar to the Brazils; whence also *Mallophora*, with its hairy body, comes, and which, thus much, resemble, the *Bombi*. *Dasypogon*, *Dioctria*, and *Asilus* are native genera, and the latter appears to be of universal distribution. But the most gigantic in the tribe are found in the genus *Mydas*, which are likewise insects of prey, and sometimes nearly two inches long. The third and fourth tribes, the *Hybotidæ* and *Empidæ*, still retain the sanguinary habits of the preceding; but they are much smaller insects; and the latter, especially, have usually very elongated rostra, and seize their prey in flight, although they do not disdain the nectar of flowers. In this same tribe, the *Hilaræ* are peculiar for the dilatation of their anterior tarsi in the males; and they have the habit of dancing upon the surface of the water in brooks and ponds without any fear of submersion. The present, is a large tribe, consisting of many genera of small insects.

(334.) The fifth tribe, or the *Vesiculosa*, are remarkably gibbous insects, with very minute heads, which are nearly lost in comparison with the rest of the body, and almost wholly occupied by their eyes; and they have also lengthy rostra, although in some it is nearly obsolete. Their wings, in repose, are placed in a sort of roof over the body. These insects are all attached to flowers, and their preliminary stages are unknown. The sixth tribe, or *Nemestrinidæ*, have a considerable resemblance to the *Bombylii*,—from which, however, the peculiar neuration of their wings estranges them; for in these organs they closely resemble *Mydas*: the two genera known are exotic and rare insects. The seventh tribe comprises the *Bombyliidæ*, which are distinguished for their short hairy body and lengthy proboscis, which is sometimes considerably longer than the insect. They have usually great power of flight, and accomplish it with remarkable velocity; and many of them take their food, like some of the sphinges and humming-birds, whilst hovering over the flower which contains it. They consist of several genera, the most of which are exotic. The eighth and last tribe of the TETRACHÆTÆ TANYSTOMA, consists of the *Anthracidæ*, —insects almost wholly remarkable for their intensely black colour, and beautiful wings, variegated with black markings, especially in the type *Anthrax* itself, and which is likewise distinguished for its reniform eggs,—a structure rarely occurring among the *Diptera*. As an elegant contrast to their deep mourning garb, they are frequently decorated with bands of bright silvery hair, which gives them an extremely beautiful appearance. They are chiefly inhabitants of the warmer climates, where they appear to abound.

(335.) The third family of the TETRACHÆTÆ, and the sixth of the entire order, is occupied by the *Brachystoma*. These have a short and membranous proboscis, the terminal lobes of which are considerably thickened: the third joint of their antennæ is simple, with its seta usually dorsal. They consist of insects of great variety of form, and are separated into four tribes; — 1. The *Xylotómidæ*; 2. *Leptidæ*; 3. *Dolichopidæ*; and, 4. *Syrphidæ*. The three first are distinguished by their lengthy and slender legs, and frequently gay metallic colouring. The majority are floral insects. In the *Leptidæ*, we find the remarkable genus *Vermileo*, the larva of which forms a pitfall for its prey, very similar to that we have described in giving the habits of the *Myrmecoleon* among the *Neuroptera*; and among the *Dolychopidæ*, the male legs of *Medeterus* are curiously distorted. The last tribe of this family we find occupied by the *Syrphidæ*, which certainly exhibit the most elegant insects throughout the *Diptera*. They are usually depressed and ornamented with beautiful colours. It forms a very large group, embracing more than forty genera; and in which, consequently, the typical organisation undergoes considerable variety of modification. In *Ceria* and *Callicera*, the antennæ are much developed, and very elegant: in *Volucella* we find a mimicking resemblance of the bee; and which, also, in the larva state, inhabit their nests: the *Helophili* are gay insects, residing in the vicinity of water, especially where there is an abundance of reeds and rushes: *Merodon*, *Tropidia*, and *Xylota* have greatly enlarged posterior thighs: *Rhingia* has an elongated clypeus and proboscis; but it is in *Syrphus*, *Milesia*, and *Cheilosia*, that perhaps the most elegant species occur: and *Baccha*, lastly, is remarkable for its lengthy and slender body.

(336.) The third general subdivision consists of the DICHÆTÆ—the characters of which are to have two setæ to the proboscis; the antennæ usually patelliform, with a dorsal seta, or tuberculiform. In these insects, also, we find a gradual obliteration of the nervures of the wings, which speedily become considerably reduced in quantity. These form two families—the *Athericera* and the *Pupipara*; the first of which is distinguished by the sucking tube being contained within the proboscis, and the terminal joint of the antennæ usually patelliform. These are subdivided into eight tribes; — 1. The *Scenopinidæ*; 2. The *Cephalopsidæ*; 3. The *Lonchopteridæ*; 4. The *Platypezidæ*; 5. The *Conopsidæ*; 6. The *Myopidæ*; 7. The *Œstridæ*; and, 8. The *Muscidæ*. The first six of these tribes have but little connecting affinity, and seem to associate themselves here, from no other situation more conveniently offering to receive them. The first exhibits the remarkable combination of a generally inferior organisation, in intimate union with wings of complicated structure. The insects, constituting but one genus, occur usually in the windows of houses. The second tribe, the *Cephalopsidæ*, are minute insects with large heads, which are nearly all eye; they are found in meadows and upon low shrubs, and but rarely frequent flowers. The third, or *Lonchopteridæ*, are also very difficult to locate: of these there is but one genus which presents the singularity of a sexual disparity in the neuration of the wings,—a structure found in the *Diptera* but rarely, as it occurs besides, only in *Penthetria* among the *Tipulæ*. The present insects occur among herbage, in marshy situations. The fourth, or *Platypezidæ*, are distinguished by their posterior tarsi being imbricated obliquely. They are rare insects, and are probably fungivorous. The fifth, or *Conopsidæ*, appear to borrow their structure from the superior and inferior groups: thus, by their antennæ, they are connected with *Ceria* among the *Syrphidæ*, and their tongue associates them with the *Muscidæ* They have a very elongate, slender, and geniculated proboscis, and in the perfect state frequent flowers, but in the larva state they live as parasites within the bodies of the *Bombi*. The next tribe, the *Myopidæ*, greatly resembles them, although sufficiently distinct, and their early stages are not known

(337) We now enter the remarkable tribe of the *Œstridæ*, which are all parasites upon some part of the body of the *Mammalia*, and it is a singular anomaly, that some of the genera which contain the largest species among them, inhabit the smallest animals Thus, *Cuterebra*, an American genus, and a giant in the group, inhabits the necks of rabbits, rats, and mice, whilst *Œstrus* inhabits the stomachs of horses, *Œdemagena*, the facial cavities of the reindeer, and *Hypoderma* forms tumours upon the backs of oxen. In their structure, they are also remarkable, as among them we find the only *Diptera* that want a mouth, which is wholly deficient in *Cephalemyia*, which inhabits sheep, *Colax*, and *Œstrus*, and in *Cuterebra* and *Hypoderma*, although there is a buccal cavity, there is no proboscis or palpi Although thus imperfectly organised, their general analogy, in many other points, to the higher divisions of the *Muscidæ*, assign to them this situation The remarkable dread with which cattle view their approach has given a name to the tribe, and animals resort to every manœuvre to prevent the insect depositing its egg upon them, but vainly; for neither swiftness nor immersion in water will evade their antagonist They are supposed to act as counter-irritants upon the system of these large animals, and thus to modify the effects of grass feeding and repletion. They certainly form a highly interesting tribe, and one that has occupied the laborious and thorough investigation of Bracy Clarke, the celebrated veterinary surgeon, whose skill and patience have elucidated the obscurities of their history.

(338) We now enter the enormous tribe of the

Muscidæ. These have been divided into three sections;—1. The *Creophilidæ;* 2. The *Anthomyidæ;* and, 3. The *Acalypteridæ.* We will give the characters, both structural and economical, peculiar to them, and then hastily notice some of the more striking genera. 1st, The *Creophilidæ* are distinguished by the setæ of the antennæ usually consisting of two or three joints, and by their wings having large alulæ. In the *Anthomyidæ*, the seta of the antennæ is not jointed, and the alulæ are but small or moderately sized; and the third section, the *Acalypteridæ*, have the face broad in both sexes, and the alulæ either rudimentary or obsolete. The *Creophilidæ* are the most powerful of the *Muscidæ:* in brilliancy of colour, rapidity of flight, and general instinct, they also surpass the rest, and usually deposit their eggs in decomposing animal substances: many of them are, however, parasitical upon other insects: this is peculiarly the case with the *Tachinæ;* and these insects exhibit bodies usually armed with rigid spines, and the setæ of their antennæ are always naked. The *Ocypteræ* are remarkable for the cylindrical slenderness of their body; and the *Gymnosoma*, for its hemispherical convexity. In the *Phasianæ,* the abdomen is considerably depressed; and their wings acquire great amplitude, and are frequently coloured, and of a thicker texture than is usual: they are powerful flies, and are gregarious in their choral aërial dances. Among the *Dexiariæ,* we find the brilliant and conspicuous New Holland *Rutiliæ*, which are the largest of the *Muscidæ*, and the most delicately metallic; and they appear to be abundant, both in species and individuals, in that island. The *Sarcophagæ*, the next sub-tribe we have had occasion to allude to in our preliminary generalities, where we have noticed their viviparous nature: they are extremely abundant, and usually chequered with ashy and silvery reflections. The seventh sub-tribe, the *Muscidæ,* have never rigid setæ upon the abdomen: they are frequently gaily coloured and metallic, although of usually sombre or dull hues. Amongst these, the remarkable genus *Achias* is distinguished by the lengthy dilatation of the sides of the head, at the extremity of which the eyes are placed. *Stomoxys* and *Hæmatobia* feed upon the blood of animals, and the majority resort to animal secretions or excretions; but it is the females only which are thus annoying. All substances, vegetable or animal, in a state of decomposition, afford pabulum for their young; and notwithstanding the celerity of these processes, their developement keeps pace with it, and these larvæ acquire maturity by the time their provender disappears.

(339.) The second section contains the *Anthomyidæ*, which are closely related in structural characters to the former, and from which it is difficult to separate them strictly. They are, however, less vigorous; and the order here visibly commences decreasing in organisation: they form a large group, which are frequently difficult to determine specifically.

(340.) The third section, the *Acalypteridæ*, exhibits seventeen sub-tribes: our space will not allow us to notice more than the most conspicuous of them, for they comprise the largest group throughout the *Diptera;* and which exhibits a progressive declension in structure and organisation, displayed chiefly in their antennæ and wings; in some of the superior sub-tribes, the former still exhibit considerable developement, which gradually decreases. Some of the most remarkable structural peculiarities are shown in the exserted ovipositor and gaily marked wings of the *Tephritidæ;* the produced scutellum of *Celyphus*, nearly covering the abdomen; the laterally dilated head in *Diopsis;* the enlargement of the anterior femora in *Ochthera*, thence named *Mantis;* and the singular and constant vibration of the wings in the *Sepsidæ* and *Ortalidæ*. The order here loses the active habits of the preceding divisions, — these insects being usually rather inert, and frequenting the shades of woods and plants, and but rarely visiting flowers and the sunshine. Some, as in the preceding tribes, feed upon decaying animal and vegetable substances, as the *Scatophagæ* and *Sapromyzæ*; others, as the *Ortalidæ* and *Tephritidæ*, deposit their eggs upon living vegetables and plants, and thus produce excrescences like galls. The *Dolichoceræ* live upon aquatic plants; *Calobata* has the power of walking upon the surface of pools; and the *Actoræ* frequent the sea-shores, where they live upon fuci and marine rejectamenta.

(341.) The sixth and last family of the *Diptera* contains the *Pupipara*. These have, for separative characters, antennæ with but one distinct joint, placed in front of the lateral extremities of the head; and a mouth without a proboscis,—the function of which is executed by two setæ, which form a sheath or tube. They constitute two tribes,—1. The *Coriaceæ*; and, 2. The *Phthiromyæ*. The first are distinguished by having a head of a moderate size, and usually wings. We have before adverted to the remarkable circumstance of their young undergoing its states of larva and pupa within the abdomen of the parent; and as matured pupæ they are born. They resemble the lice, living as parasites upon animals and birds; and although, when winged, they are not skilful flyers, yet, in their native habitat, upon the skin of animals, they have considerable activity, running about, but chiefly laterally. Belonging to the first group, and winged, we find *Hippobosca*, or the horse-fly; *Strebla*, inhabiting the bat; *Ornithobia* and *Ornithomya*, upon a variety of birds; and *Anapera* (*Oxypterum* Leach) and *Stenopteryx*, exclusively upon swallows. *Leptotena* has but rudimentary wings, and inhabits the deer; and *Mallophaga*, which is totally apterous, the sheep. The second tribe, the *Phthiromyæ*, contains but one genus,—*Nycteribia*—animals whose situation is indicated as being proximate to the *Hippoboscidæ*, by the structure of their mouth and the identity of transformations. These insects greatly resemble spiders; and thus indicate the contiguity of the *Arachnidæ*, although their structure is completely analogous to that of the hexapod *Insecta*. A particular detail of this would exceed the limits we are restricted to; and we shall therefore merely notice that they have a small conical head, attached by a tough membrane to the upper anterior surface of the thorax; two simple eyes placed on each side of its anterior angles; their antennæ are two-jointed, flat, and placed closely together within the anterior emargination of the head; the head, thorax, and abdomen, are distinct; the legs are long; tarsi pentamerous,—the basal joint being very lengthy, the terminal joint very robust, and with large claws; and, attached to the base of the intermediate legs, there is, on each side, a curved pectinated process, apparently the analogue of wings. These remarkable insects inhabit different kinds of bats, and, as far as they are yet known, they are peculiar to the Old World, being found in Europe, India, and the Mauritius.

(342.) Having completed, with the *Diptera*, the view of six-legged insects that undergo a true metamorphosis, excepting only the small sixth section of the present chapter, containing the *Suctoria*, we have now to give a summary of the contents of the other divisions of the *Articulata*, which have not entered within the preceding synopsis. According to the series above laid down, the *Arachnidæ* or spiders succeed the *Diptera*, to which they are apparently allied by the last genus in that order, *Nycteribia*. Both physiologically and physiognomically, they exhibit marked differences from the true *Insecta*: thus, the head is no longer distinctly separated from the thorax, and they have no antennæ; besides, they have four pairs of legs; their eyes are always simple, and usually consist of six or eight, disposed in a variety of ways on the top of the cephalothorax,—the number and arrangement of which have greatly helped towards their systematic distribution. Although possessing no evident and distinct organ of hearing, it cannot be doubted that they have a perception of sound, and touch is acutely performed by their extremely sensible tarsi and palpi. In a large division of them, we observe the usual tracheal respiration of the hexapod *Insecta* transferred into a pulmonary apparatus, and in these there is a complete circulating system, which in the *Insecta* we have always observed to be either partial or imperfect—at all events, certainly not obvious. Their instincts are apparently very perfect, and even capable of striking developement; they are very sanguinary in disposition, and consequently require the full exercise of these faculties to circumvent their prey, from the latter being instinctively apprehensive of their natural enemies. Although best known to ordinary observers from the nets spread forth by many for the purpose of intercepting their supplies of food, and by the elegant reticulation of this delicate filament, which is a glutinous silk, secreted in a liquid state within the body, and transuded through a cluster of small nipples at the apex of the abdomen, yet very many do not possess the means of weaving this web, whence the order has obtained its classical name; but they roam forth or form pitfalls, and exercise their ingenuity in a variety of ways to obtain their requisite supplies of provisions, which we shall briefly see below. Throughout nature, the two primary functions exercised by animals are self-preservation and the propagation of the species: these are universally obvious; but in their execution, others, conjunctive and collateral, are ellicited, which depend, however, more or less upon the difficulties or facilities that impede or promote the accomplishment of the former. The exercise of the second of these primary functions, the propagation of the species, seems to demand in these creatures as much sagacity as the first; for, from their sanguinary habits, the least powerful individual in this intercourse, must, by some stratagem, elude the fate that inevitably attends it, unless this be resorted to: a remarkable fact, that that passion which tames the bold, and gives courage to the timid, and edulcorates all, here loses its distinctive characteristics, and its usually absolute predominancy; for it is frequently lost in the superior energy of that which prompts self-preservation. The integument of these animals is often a flexible membrane, although in many it retains the several peculiarities of structure found in the normal

Ptilota. From these loose generalities, we must proceed to the distribution.

(343.) It will be of little moment that we invert the order of affinities, as by it we shall save ourselves from the inconsequence of treating the least typical first. Thus, they are divided into the pulmonary *Arachnidæ*, and the tracheal *Arachnidæ*; the latter, of course, most closely allied to the hexapod *Insecta*, although the smaller division of the pulmonary *Arachnidæ* are the most typical, and the most abundant. these are further divided into — 1. *Araneidæ*; 2. *Phryneidæ*; and, 3. the *Scorpionidæ*. The tracheal *Arachnidæ* comprise — 4. the *Solpugidæ*; 5. *Phalangidæ*; and, 6. the *Acaridæ*. Of the first, the *Araneidæ*, we have a further division into terrestrial and aquatic. The former inhabit the earth, and are either suspended in the air, or cavities in rocks or trees, or they are affixed to plants, or else they occupy holes in the ground; whereas the aquatic *Araneidæ* dwell in the midst of the water, in a cell filled with air. The former are divided into *Theraphoses* and *Arachnæ* proper. In the *Theraphoses*, the mandibles are articulated horizontally, having a vertical motion; and, in the *Arachnæ*, they are articulated either vertically, or upon an inclined plane, and have a lateral motion. In the former group of *Theraphoses*, we find the large and powerful *Mygale*, the most robust insects of the order. The fact has been doubted, of these catching birds in their nets, and feeding upon them; but the probability of this has been substantiated and confirmed by a communication we have recently received from W. S. MacLeay, Esq. who informs us, that in the vicinity of Sydney, N. S. W., he has met with a true bird-catching spider, — having himself found one of the *Epeiridæ* actually devouring the young of a *Gasterops*, that had, no doubt, lately flown from the nest; and which is not a solitary instance, as his father, A. MacLeay, Esq., had previously observed a similar fact. He therefore retracts his observations upon *Mygale* in the *Zoological Transactions*; for here, evidently, is a spider which feeds upon the juices of a warm-blooded animal.*

(344.) The *Arachnæ* may be divided into—1st. Those which are the *Vagabonda*, which quit their dwellings to chase and catch their prey; 2dly, The Wanderers, which roam about in the vicinity of the nests they have constructed, or the nets they have spread to entangle their prey, and, 3dly, Those which are sedentary, which construct large nets for the apprehension of their prey, and in the centre or sides of which they lurk, awaiting it. Among the *Vagabonda*, we find some with six eyes, and others with eight. Those with six form either tubes or cells of silk, within which they dwell; and those constitute the genera *Dysdera*, *Segestria*, *Uptiotes*, &c. The possession of eight eyes, we, however, find the most prevalent peculiarity, being all but universal in this division. Among the *Vagabonde* with eight eyes, we observe the *Runners*,—those which run with agility to catch their prey, including *Lycosus*, *Sphasus*, *Ctenus*, &c.; the *Leapers*,—those which leap and jump lightly upon their prey, as *Myrmecia*, *Eresus*, *Attus*, or *Salticus*, &c.; and the *Walkers*, which walk laterally and backwards, and occasionally spread nets to supply themselves with provisions.

(345.) In the second division, or WANDERERS, we find—1. The *Niditèles*, which form a web of their nests, whither filaments converge, by which they catch their prey; they consist of *Clubiona*, *Desis*, and *Drassus*: 2. The *Filitèles*, which spread long filaments of silk wherever they move, to catch theirs; and here we find *Clotho*, *Enyo*, *Pholcus*, &c.: 3. *Tapitèles*, which manufacture large webs of a close tissue, and within which they reside, awaiting their prey; and here we have *Tegenaria*, *Lachesis*, &c.: 4. The *Orbitèles*, which construct webs with open meshes, and formed either in regular concentric circles, or in spirals, and which lurk either in the centre or at the side, awaiting the entanglement of their victims; here we have *Epeira*, *Tetragnatha*, *Zosis*, &c.: 5. The *Napitèles*, which spread wide nets of a web of close texture, suspended among irregular chambers; this, as far as yet observed, is confined to the genus *Linyphia*: and, 6. and lastly, The *Retitèles*, which form webs with open meshes and irregular chambers, and which lurk in the centre, or at the sides; these comprise *Argus* and *Theridion*, &c. The aquatic *Araneidæ* consists of the single genus *Argyroneta*, which spreads filaments in the water, which catches for them their food. We have not space to notice further the interesting peculiarities incidental to these insects, and have room only to mention that it is in the genus *Lycosa*, among the *Vagabondæ*, that the celebrated *Tarantula* occurs,—the effects of the venom of which is reputed to be cured only by the violent exertion of a dance produced involuntarily by the music of a guitar. The name of the insect is derived from the city of Tarentum, in Italy, in the vicinity of which they occur in profusion.

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* From a letter to me dated 7th April, 1840, brought by Mr. Gould from Sydney. [W. E. Sh.]

(346.) The *Phryneidæ*, or second division of the pulmonary *Arachnidæ*, are distinguished from the first, by their anterior legs being not ungulated, and very like antennæ, and possibly executing similar functions; and the maxillary palpi very spinose, and terminating either in hooks or chelæ. They consist of two genera—*Phrynus* and *Thelyphonus*. They are inhabitants of the intertropical regions of the Old and New World. The latter is distinguished from the former, by having a long and slender tail, and more robust maxillary palpi. Their habits are not known, but they are much feared in the countries where they occur; and they are of a malignant aspect, and comparatively large.

(347.) The scorpions form the third division. These are readily distinguished from all the former, by their enlarged maxillary palpi, which here form a prehensile organ, greatly resembling, to use a familiar illustration, the claw of a lobster: they have an elongate annulated abdomen, with no deep constriction or separation between the thorax and abdomen; eight unguiculated legs; and a tail of six joints, separated from each other by a deep strangulation,— the last bearing a curved hook, whereby the insect inflicts a wound and injects a poison. These are terrific creatures, whose poison becomes the more virulent as they approach the torrid zone. None, fortunately, are natives of this country, but several occur in the South of Europe.

(348.) The *Solpugidæ*, the first division of the tracheal *Arachnidæ*, are equally hideous with the last in aspect,—being usually covered with long hairs or spines; and are said to be also venomous; but, if so, the poison must be injected by the mandibles. They have the head, thorax, and abdomen, separated by a strangulation. They have eight legs,—the anterior pair being palpiform, as are also their maxillæ, whilst their mandibles form robust didactyle claws; and their abdomen consists of a succession of segments. They frequent hot countries and sandy districts, especially of the Old World. They run with great rapidity, holding up their heads as if to defend themselves. With these, doubtlessly, *Chelifer* and *Obisium* may be united; which are minute animals, both natives of our own country, where they frequently occur in moss. The second division consists of the *Phalangidæ*, in which the head, thorax, and abdomen are united, and the latter not divided into segments, but by its epidermis being frequently folded,— it thus resembles a segmental division. Their mandibles are very robust, and with didactyle claws, eight unguiculated legs, and either slender and filiform or spinose palpi. Their legs are usually exceedingly long and very slender. Some occur in this country, but perhaps the most eccentric forms among them are found in *Gonoleptes* and its affinities, from the Brazils. They usually occur running upon the ground or on plants, and are very active; some also are found under stones, or in moss.

(349.) The last tribe of the *Arachnidæ* are the *Acaridæ*, or mites. Head, thorax, and abdomen are here usually united: their abdomen is not divided into segments: they have eight legs; and their mouth is haustellate or consisting of pieces, which form a sucking tube. These comprise an extensive tribe of creatures, which are excessively prolific, consisting also of many genera, as *Trombidium*, *Gamasus*, *Ixodes*, *Bdella*, &c. The majority are very small, and occur every where beneath stones, in moss, under the barks of trees, in flour, dried provisions, old cheese, &c.; others live as parasites upon the skin or in the flesh of animals; and some are said to be the cause of certain loathsome diseases which affect humanity,—the itch, for instance: they are found upon other insects; and some have even been observed in the eyes and brain of man.

(350.) Our third division of the *Aptera* consists of the Myriapoda, or, as they are usually called, hundred legs: they constitute the *Chilognatha* and the *Chilopoda*, and undergo a partial metamorphosis, which consists in their acquiring, with every progressive moult, an additional number of segments and legs. The former have short antennæ; a convex cylindrical body, surrounded by a hard integument; neither maxillæ nor palpi; short mandibles, and short and slender legs. They occur usually in humid situations, and beneath the bark of trees; and they feed upon both animal and vegetable productions. They consist of *Glomeris*, *Iülus*, *Polydesmus*, &c. &c. The *Chilopoda* have elongate antennæ, a depressed body covered with coriaceous plates, and legs of very variable length: those with unequal legs constitute *Scolopendra* proper, and its subdivisions, among which is the electrical *Geophilus*. Those with equal legs have those limbs very long, and form the genera *Cermatia* and *Scutigera*. All of these run very fast; they are carnivorous and nocturnal, and the majority occur beneath stones, the bark of trees, and in humid loose earth. The most of the exotic species are of large size, and are said to be venomous. The rest, which do not undergo a metamorphosis beyond a change of skin, and which form the aberrant portions of the circle, if indeed they belong here, consist of Leach's two orders, *Thysanura* and *Anoplura:* and are all hexapods, the former are covered with hair or scales, and the tail has filaments or setæ whereby they jump; they are very active, and occur in neglected collections or among rejectamenta and refuse. They comprise *Lepisma, Forbicina,* *Podura,* &c.; in the latter, the forked tail is bent beneath the abdomen, and forms a leaping apparatus. The *Anoplura* consist of the lice, which are all parasites,—some one being peculiar to all animals and birds; and one, in particular, is the cause of a disgusting disease, the Phthiriasis,—instances of which now rarely occur, but which was comparatively common during the middle ages.

(351.) The fourth division of the *Aptera*, the CRUSTACEA, is allied to the *Myriapoda* by means of *Oniscus;* but here again, in this order, we shall reverse the affinities, and proceed in a declining line from the superior to the inferior. The subject of a metamorphosis we have before noticed, in speaking of Mr. Thompson's researches, and shall not resume it here, farther than by observing that it has very recently been confirmed by Rathke.* In speaking of the order generally, we may observe, that although they possess symmetrical forms, yet is it combined with such eccentric extravagance as to outrage all preconceived notions of elegance and beauty. How it was that many of them were ever selected as choice comestibles, we know not; and it must certainly be considered a vagary of human caprice, which can sit down with zest to a lobster or crab salad, that would turn with disgust from a stew of caterpillars, although the latter are by far the most cleanly feeders. Did the public appetite take this turn, we should not then vainly ask for remedies against the destroyers of our crops, but which would thus yield us other crops equally serviceable and beneficial! This division combines structural differences and peculiarities far more varied than we observed in the *Arachnidæ*, but which we must treat more briefly, for our space precludes the amplitude of detail that can alone make such particulars instructive or amusing;

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* Wiegman's Archiv., part iii. 1840.

and knowing so little as we do of the habits of these creatures, — they being chiefly natives of the ocean and its recesses, — it is, consequently, only from their structural details that they derive an interest. These are as distinctively inhabitants of the water as the metamorphotic hexapod *Insecta* are of the land. Their integument is usually harsh, hard, brittle, and crustaceous; whence their name: and that which generally covers conjunctively the head and thorax, is called, technically, the *carapax*, or shield. We think this integument cannot be considered thoroughly analogous to the dermo-skeleton of the hexapod insecta, as it is more independent of muscular attachment. Waiving the difficulties and question of their preliminary transformations, we find that their growth is subsequently effected by casting their skin, which they, as it were, creep out of; in which state the animal becomes sickly and seeks solitude. These creatures have two pairs of antennæ, and a mouth furnished laterally with numerous appendages. It is sometimes true legs which surround the mouth, and which thus perform the double function of maxillæ and legs; but, in general, many of them are devoted exclusively to the prehension of food; and, as we descend the series, we observe a proportionate decrease of these appendages, and an increase of the number of legs: the latter are affixed to the thorax; they generally consist of five or seven pairs, and their form varies with their function, whether for the use of swimming, walking, or prehension: in the first case, they are broad and more or less membranous; in the second, slender and lengthy; and, when formed for prehension, they terminate in a claw. Beyond the legs, and attached to the successive segments of the abdomen, there is a double row of appendages which assist them to swim and to carry their eggs. These few generalities must suffice: of course, great variations and modifications are found; but the insects themselves take their definite grouping chiefly from the arrangement, disposition, uses, and structure of the legs. They constitute two large divisions, the masticating and suctorial *Crustacea*, of very unequal extent; the former being by far the most numerous, and the former are likewise subdivided into two further groups according to whether their eyes are pedunculated or sessile.

(352.) Those with pedunculated eyes are subdivided into decapod and stomapod *Crustacea*. The former of these contain the greatest number of genera throughout the group, and also considerably the largest animals: they have usually five pairs of legs, and are subdivided into, first, decapod *Brachyura*, known as crabs. The structure of the abdomen of which is very remarkable, forming a sort of leaf, disproportionately small, and which folds back upon the under side of the thorax. It is quite impossible that we should go into further detail here of their subdivisions; and all that we can do, therefore, will be to exhibit some of the more prominent genera, distinguished either by their economical uses or their habits. Amongst them is the genuine crab of our tables,—the *Cancer Pagurus*,—the type of the entire group, the flesh of which is much esteemed and considerably used. Among the quadrilateral crabs, we observe the genus *Thelphusa*, peculiar for inhabiting fresh waters, and the power they possess of living a week or even a month away from the water. These animals are common in the limpid lakes and streams of the South of Europe, and are sought as great delicacies. It is this species which is represented upon the ancient coins of Agrigentum in Sicily. In this same division we find the genera *Gecarcinus* and *Cardisoma*. These are the celebrated *Tourlourous*, or land crabs, called also violet crabs and white crabs from their colour, and are natives of the West India islands and South America. They are very courageous, and try to intimidate by the clatter of their claws, and they pinch very severely. The history of these creatures presents some of the most extraordinary phenomena throughout entomology, that we cannot forbear giving a rapid sketch of it. Their usual habitat is in the mountains, away from the sea and water, where they reside within cavities or burrows of the earth, and rocks, or in hollow trees: they feed variously; and it is known that they will prey as freely upon putrid carcases,—disputing their possession with the vulture,—as upon fruits and vegetables; and yet they are esteemed and used as delicate and choice articles of food. Their instinct prompts them, at the period of oviposition, to seek the shores of the ocean, and therein to deposit their eggs; and this migration they execute in such multitudes, that the land is literally covered with them; and their progress is as direct and destructive as a stream of lava, passing over every thing. Having arrived on the coast, they bathe themselves, and then deposit their eggs; and this accomplished, they again seek their former habitats,—but, of course, in a considerably exhausted state; and they therefore frequently halt, and repose on their journey. Having regained their domicile, they undergo their moult, which is a critical period in their lives; and to shelter them from external injury, as they are then soft and sickly, their integument resembling wet parchment, they closely shut themselves in their burrows; and it is now that their flesh is most esteemed. Their eggs, meantime, being recast upon the sand, are speedily hatched by a combination of heat and moisture; when the young hasten to the adjoining fields, where they gradually acquire the strength and size requisite to enable them to undertake their migration to the haunts of their parents. They are chiefly nocturnal animals, migrating and preying at night. It is a remarkable fact, that, although furnished with branchiæ, their vitality is suspended by immersion in water; and also that they possess a cavity in the vicinity of their respiratory apparatus, which serves as a reservoir for the water requisite to keep those organs constantly moistened. The neighbouring *Gelasimus* is singular for the excessive developement of one of its claws, which is sometimes larger than the whole of the rest of the body, and serves it to close the aperture of its burrow, when it has retired. The habit it has of raising this, as if calling, has procured it its specific name of *G. vocans*. The genus *Nautilograpsus* consists of small animals, which float about, in the ocean, upon marine plants; and it is supposed that it was one of these which indicated to Columbus, some days before his discovery, the proximity of the New World. The sub-parasitical *Pinnotheres* are also singular, from inhabiting, at certain seasons, the bivalve shells of some of the *Mollusca*. Among the curious genera which form the passage from the *Brachyura* to the *Macroura*, or large-tailed division of the decapod *Crustacea* (the lobster), we find those in which the enlarged tail has not yet become the chief organ of progression, by means of its violent and sudden concussion; and among these, the *Pagurus*, or hermit lobster, is worthy notice, from its habit, in consequence of its tail being always soft, of seeking for its protection some univalve shell, wherein it buries it; and these shells, with its progressive enlargement, it has the instinct to change. The allied *Birgus*, which, from its size, cannot find shells convenient for its reception, lives naked, and has the habit of dwelling for a long time, like the land crabs, in cavities of rocks and burrows of the ground. The normal *Macroura* contain the large *Palinurus homarus*, or sea crayfish, which has not didactyle claws; the *Astacus Gammarus*, or lobster; the *Astâcus fluviatilis*, or river crayfish,—both with large anterior chelated claws; the former marine, and the latter inhabiting the fresh water; the *Crangon*, or shrimp; and the *Palæmon*, or prawn,—delicacies for the breakfast table; and multitudes of others.

(353.) Among the *Stomapoda*, or sea mantises,—named thus from their spined raptorial anterior legs,—occur *Squilla* and its allies; and near these, but without such legs, we find the genus *Phyllosoma*: their leaf-like bodies, indicated by their name, are as flat and transparent as a piece of stamped mica; their head is disproportionately large, and abdomen equally small.

(354.) The second division of the *Crustacea*, the *Edriophthalma*, or those with sessile eyes, contains three groups;—the *Crustacea Amphipoda*, which constitute the various genera of those compressed shrimp-like jumping *Crustacea* we find so frequently in stagnant waters, such as *Talitrus*, *Gammarus*, *Phronime*, &c.; the *Crustacea Læmodipoda* contains *Cyamus*, &c., which live as parasites upon the whales and others, as *Caprella*, are wanderers; the *Crustacea Isopoda* are broad and depressed, and do not leap: among these we find *Oniscus*, or the woodlice; the *Cymothoæ*, which are parasites, and very broad; and *Idotea*, which are equally slender. To this division, the fossil *Trilobites* very closely approach in general structure.

(355.) The *Entomostraca* form the last division of the *Crustacea*. In these are the *Branchiopodes*, containing the remarkable forms of *Monoculos*, or *Cyclops*, which are very minute and pyriform insects; *Zoe*, with its digitated legs; [illegible] with its case covering its body. It is here, doubtlessly, that the extraordinary form of *Limulus* should come: these are large creatures sometimes two feet long, and peculiar to the seas of America and India; specimens frequently occur in Chinese boxes of insects; they have a large hemispherical crust covering the anterior portion of the body, and a long and slender tail: and lastly, the *Pœcilopoda*, which comprise the only truly suctorial *Crustacea*; among which there have been observed, in their early stages, considerable transformations. They live chiefly as parasites upon other animals, and especially fishes. Amongst them, *Argulus* has natatorial legs, and *Cecrops* is short and stout, without legs; and *Dichelestion*, which is parasitical upon the sturgeon, is long and slender. Naturalists have not fully determined where the *Pycnogonidæ* should be placed, — whether proximate to *Phalangium* among the *Arachnidæ*, or with the *Crustacea*, linking the two orders: Latreille adopts the former view; but Walckenaer and Milne Edwards, respectively the greatest authorities in their two branches of Arachneology and Crustaceology, concur in considering them crustaceous. They are spider-looking creatures, with eight very long and ungulated legs; but, in addition to these, the females have two pseudo legs for carrying their eggs. They are occasionally found upon the *Cetacea*, upon which they are supposed to be parasitical, although they also occur upon marine plants and under stones on the sea shore. They contain the genera *Pycnogonon*, *Nymphon*, &c.

(356.) Our last division of the *Aptera* contains the *Suctoria;* the most typical of which is the genus *Pulex*, which undergoes a metamorphosis resembling that of the *Diptera*. We need not enlarge upon the flea, as the space we could devote to it would not be ample enough to do it justice, and it is sufficiently well known; we may remark, however, that it contains, besides the common flea, others that are peculiar to certain animals, as well as the renowned *Chigo* of the West Indies, so injurious to the feet of the negroes. With these insects we conclude our survey of annulose animals.

(357.) The synopsis we have thus rapidly passed through, must be considered only as suggestions, and stimulants to further inquiry; and should it prove so, we shall have gained our object, as it is but requisite to procure attention to the subject, to invest it with a paramount interest. The accidental discovery of some fragment of man's works, which had been buried for a few centuries, and then brought unexpectedly to light, produces a tumult of comment; the learned world, in the frenzy of its excitement, deduces from it, howsoever grotesque and rude, irrefragable proofs of the antiquity of man's civilisation, and of the supremacy of his intellect; and Egyptian monsters and Persepolitan figments are unfortunately too frequently esteemed more worthy of investigation than the perfect works of GOD's hands,—old as the creation of the world, yet descending to us in all their pristine completeness, which is not merely external, but also internal,—composed, too, of the minutest parts, the ultimate structure of which eludes the microscope's research;—and both external and internal corresponding in so intimate a concatenation of cause and effect, and these so harmoniously blended, and so finely united, that even the profoundest speculations of man's boasted intelligence cannot determine which is cause and which effect,—being, as they seem, simultaneous: and into all there is infused the mysterious spirit of life, making them free and active agents, endowed, to the extent and variety of their organisation, with perceptions fitted for its fullest enjoyment; and these, so governed by recondite influences that control them, that, in seeking and effecting their own weal, they work concurrently for the common weal of all. The student of this world of wonders can patiently endure the contumely of those, who, busied in the noisy mart of social life, sneer with contempt upon his pursuits; for he knows full well, that a day will come, when these traffickers in human flesh and human misery who accumulate wealth distilled from human blood, for no end but accumulation and ostentation, shall be scourged from God's living Temple; and that the exalted shall be humbled, and the humble exalted.

(358.) We cannot better conclude the present work, and the series to which it forms the sequel, than in the words of an eminent advocate of the representative system. The precursory suffrage of the great Bacon shall terminate our labours: he says*, "Was not the Persian magic a reduction or correspondence of the principles and architectures of Nature to the rules and policy of governments? Is not the precept of a musician, to fall from a discord or harsh accord upon a concord or sweet accord, alike true in affection? Is not the trope of music, to avoid or slide from the close or cadence, common with the trope of rhetoric, of deceiving expectation. Is not the delight of the quavering upon a stop in music, the same with the playing of light upon the water?

'Splendet tremulo sub lumine pontus.'

Are not the organs of the senses of one kind with the organs of reflection,—the eye with a glass, the ear with a cave, or straight, determined, and bounded? NEITHER ARE THESE ONLY SIMILITUDES, AS MEN OF NARROW OBSERVATION MAY CONCEIVE THEM TO BE, BUT THE SAME FOOTSTEPS OF NATURE, TREADING OR PRINTING UPON SEVERAL SUBJECTS OR MATTERS." [(327—358.) W. E. Sh.]

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* Advancement of Learning, p. 151. ed. 1825.

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